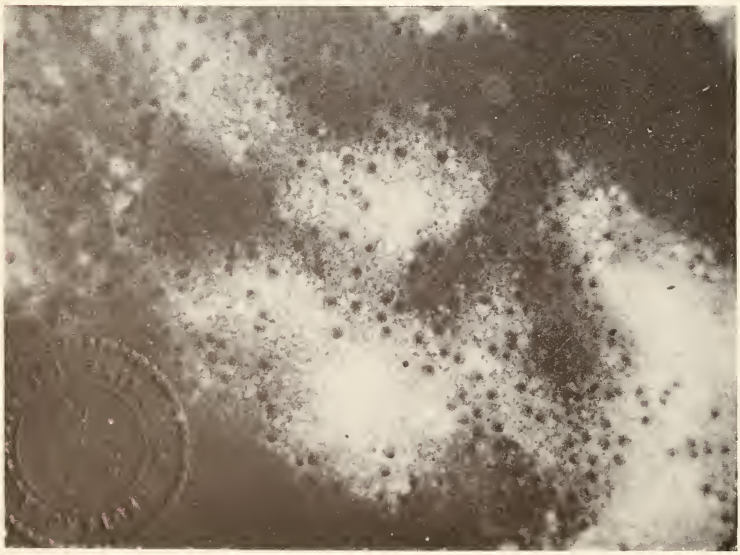
BADHAMIA UTRICULARIS Berk.

Plasmodium spreading on glass, stained with picrocarmine, magnified 15 times.



Part of the same, showing nuclei, magnified 400 times.

A MONOGRAPH

OF THE

MYCETOZOA

BEING

A DESCRIPTIVE CATALOGUE

OF THE SPECIES IN THE

HERBARIUM OF THE BRITISH MUSEUM.

ILLUSTRATED WITH SEVENTY-EIGHT PLATES
AND FIFTY-ONE WOODCUTS.

BY

ARTHUR LISTER, F.L.S.

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PREFATORY NOTE.

THE collection of specimens of Mycetozoa in the Herbarium of the British Museum has been greatly increased in recent years. The additions include the large collection of the late C. E. Broome, bequeathed by him to the Museum, and that of H. W. Ravenel, purchased from his widow.

It was necessary to make a critical examination of the whole of the materials in the Herbarium. Mr. Arthur Lister, who has devoted much attention to these organisms, was fortunately able to undertake this work; and he agreed at the same time to prepare a monograph of the whole class based on this examination.

This volume, the result of his labours, contains descriptions not only from the specimens in the Museum, but also from types in various public and private Herbaria, and from his own rich collection. Mr. Lister has generously presented a large series of specimens to the Museum, so that the Herbarium now contains types of all the species described by him in this monograph.

The volume is fully illustrated with plates mechanically reproduced from faithful water-colour drawings by the author and by his accomplished daughter, to whom in the Introduction Mr. Lister acknowledges his obligations.

WILLIAM CARRUTHERS.

November, 1894.

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INTRODUCTION.

Fries gave the name of *Myxogastres*, in 1833, to the group of organisms described in this Monograph, placing it among the Gasteromycetous Fungi. In 1836 Wallroth substituted the term *Myxomycetes* (Schleimpilze) for the older name, and this came to be the generally accepted designation. Later investigations showed that the spores, instead of producing a mycelium, as in the case of fungi, gave birth to *swarm-cells*, which coalesce to form a *plasmodium*. In consequence of this discovery, which indicated a relationship with the lower forms of animal life, de Bary in 1858 introduced the name *Mycetozoa*. Under this head he still retained the term *Myxomycetes* for the section so named by Wallroth, but linked with them the *Acrasieæ* of Van Tieghem, a small group inhabiting the excrement of animals; in these the spores are said to produce swarm-cells, as in the *Myxomycetes*, which multiply by division but do not coalesce to form a plasmodium. At a certain period, when the fruits are about to be formed, they become attached in branching strings which concentrate to a point, where they are massed together in aggregations of more or less definite shape; the swarm-cells, however, do not lose their individuality. In *Dictyostelium*, a genus of the *Acrasieæ*, a stalk is formed by the arrangement of a number of swarm-cells in vertical rows in the centre of the heap; the surrounding amœboid bodies creep up this stalk and form a globose cluster at the extremity; here each amœboid swarm-cell acquires a spore-wall, and they become a naked aggregation of spores not enclosed by a definite sporangium-wall. Rostafinski followed de Bary in the view that the formation of a plasmodium indicates a wide separation in the natural position of the *Myxomycetes* from the fungi, but he suppressed that name entirely, adopting de Bary's class name *Mycetozoa* in its place; at the same time, he admitted into his Monograph *Dictyostelium*, a genus of the *Acrasieæ*. The reason for his including this genus may be the fact pointed out by de Bary, that Brefeld in first describing the dense aggregations of swarm-cells into the stalked spore-masses of *Dictyostelium*, refers to them as being "plasmodia; that is, products of the coalescence of swarm-cells;" and it was not until after the publication of Rostafinski's

Monograph that Van Tieghem in 1880 and Brefeld in 1884 corrected this view. Accepting the *Mycetozoa* as established by Rostafinski, but excluding *Dictyostelium* on the ground of its not forming a true plasmodium, we have a clearly defined group of organisms separated from all others by the following combination of characters. A spore provided with a firm wall produces on germination an amœboid swarm-cell which soon acquires a flagellum. The swarm-cells multiply by division and subsequently coalesce to form a plasmodium which exhibits a rhythmic streaming. The plasmodium gives rise to fruits which consist of supporting structures and spores; in the *Endosporeæ* these have the form of sporangia, each having a wall within which the free spores are developed. A capillitium or system of threads forming a scaffolding among the spores is present in most genera. In the *Exosporeæ* the fruits consist of sporophores bearing numerous spores on their surface.

The Spore and Swarm-cell.—The spores of the *Endosporeæ* are mostly spherical, but occasionally they are ellipsoid. Their size is uniform in each species, or with so little variation that their measurement affords a valuable character for specific determination. This is not without exception; for instance, in the abundant species *Leocarpus fragilis* the spores are commonly 11 to 12 μ diameter, but in occasional gatherings they average 16 to 20 μ. In other genera which present ample material for comparison, similar variation is sometimes met with. The spore-wall is variously coloured in the different species. It is described by Zopf as showing the chemical reaction of cellulose, and consisting of a simple firm membrane;* but the spores of several species of *Didymium* and *Trichia*, when crushed in an acetic solution of gentian-violet, show the existence of two layers, the inner more delicate and appearing less deeply stained than the outer. In *Physarum*, *Arcyria*, and genera with thin-walled spores, the double layer has not been traced. It is either smooth or marked with sculpture. The contents of the spore consists of faintly granular protoplasm with a single central nucleus. In abnormal developments, monstrous spores, often of irregular shape and containing several nuclei, are of frequent occurrence.

The length of time that elapses before the germination of the spore after it has been placed in water varies with the species, and often in different gatherings of the same species. In the darker spores of *Stemonitis fusca* it does not begin for nine or twelve hours, while in the pale-spored variety it has been observed to occur in twenty-eight minutes. In *Reticularia Lycoperdon* it usually takes place in less than an hour in fresh gatherings; spores from a specimen which had been stored for nearly three years began to germinate in four hours, and in twenty hours nearly every spore had done so. *Didymium difforme*

* Schenk, "Handbuch der Botanik," Bd. iii. 2, 1884; "Die Pilzthiere," p. 53.

produced abundant swarm-cells in twenty-eight hours, after three years and nine months from the date of collection, and in a few days all the spores appeared to have germinated, and plasmodia were formed in a moist chamber. Sporangia were developed eleven days after the sowing of the spores. The spore-wall is ruptured by the swelling of the contents, which slowly emerges through the opening, and in about ten minutes lies as a nearly pellucid globule by the side of the empty membrane; after remaining quiescent for a few minutes amœboid movements begin to take place, and shortly afterwards the flagellum is produced. This is at first a somewhat tentative process, and the flagellum is frequently withdrawn; but in about a quarter of an hour it acquires its full length of about 15 μ, and by its lashing strokes the swarm-cell swims off with a dancing movement. At this stage it is pyriform in shape, the interior body-substance is granular and contains a contractile vacuole, and often one or more vacuoles in addition which do not usually show contraction. At the narrow end is placed the nucleus, which can easily be recognised by its lighter and more homogeneous appearance and central nucleolus. The nucleus does not alter its position, though constant movement is observed among the constituents of the granular part. The whole is enclosed by a layer of hyaloplasm devoid of granular particles, and of extreme tenuity over most of the surface, but thicker at the anterior end, where it is produced into the flagellum immediately in front of the nucleus, and also at the posterior end, where it often extends in a brush of two to eight more or less slender pseudopodia. In addition to the dancing motion, which is maintained as long as they are free in the water, the swarm-cells when they come to rest exhibit movements of an amœboid character, and spread with an irregular outline; or they assume a linear form and creep over a level surface with a snail-like motion, the flagellum being extended in advance. In this position the movement of the interior substance is seen to advantage. In the large swarm-cells of *Amaurochæte atra* it may almost be described as streaming, the granules passing from one end to the other in constant flow; the hyaloplasmic extension at the posterior end continually changes its form and often detaches portions which cannot

FIG. 1.—DIDYMIUM DIFFORME Duby.

a. Spore.
b. Swarm-cell escaping from the spore-case.
c. Newly hatched swarm-cell containing a nucleus and three vacuoles.
d. Flagellated swarm-cell.
e. Swarm-cell, with two vacuoles containing bacteria, and produced at the posterior end into pseudopodia, to one of which a bacterium is attached.
f. Amœboid swarm-cell.
Magnified 720 times.

be distinguished from the rest of the hyaline element, and appear to contain refuse matter. After a time the creeping movement is again exchanged for the dancing. In all cultivations of germinating spores, a number of the swarm-cells, after a short period of activity, withdraw the flagellum and become encysted in a globular form, as the *microcysts* of Cienkowski. After being dried and re-wetted, the contents bursts the membranous cyst-wall, which remains as an empty hyaline sac, and emerges to resume the swarm-cell form. If bacteria are introduced into a cultivation of swarm-cells on the stage of the microscope, they are seen to be laid hold of by the pseudopodia and drawn into the body of the swarm-cells, where they are enclosed in a digestive vacuole. Several bacteria are brought in turn to the same chamber, or fresh captures are conveyed into one or more additional vacuoles. The protrusion of pseudopodia usually ceases after such ingestion, and that part of the swarm-cell takes a rounded form. In the course of an hour or two the bacteria are assimilated, and the digestive vacuoles disappear. Unicellular algæ and inorganic matter are sometimes taken in, which after a time are again discharged. Both ingress and egress are observed to take place only at the posterior end.* De Bary stated that swarm-cells derive their support only from nutrient matter in solution,† and it may be that they are to some extent nourished in this manner; but considering the large number of species belonging to different genera which have been observed to prey actively on bacteria, it cannot be doubted that these form an important part of their food.

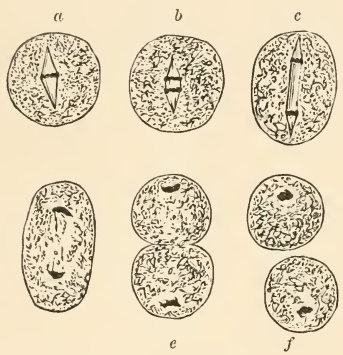

FIG. 2.—AMAUROCHÆTE ATRA Rost.

a to *f*. Successive stages in bipartition of swarm-cell, accompanied by the division of the nucleus by karyokinesis. Magnified 1200 times. Drawn from stained preparations in Canada balsam.

Bipartition of the swarm-cells is observed to begin in a few hours after they leave the spore-membrane, and we may conclude with de Bary that the process is frequently repeated, for it may be seen constantly taking place for three or four consecutive days in cultivations, during which time the numbers increase very largely. The bipartition is preceded by the withdrawal of the flagellum and the swarm-cell taking a spherical form. The nucleus then divides by karyokinesis. The earliest stage which I have observed is that of the nuclear-spindle with an equatorial

* Lister, "On the Ingestion of Food Material by the Swarm-Cells of *Mycetozoa*." *Linn. Soc. Journ. Bot.*, 1889, vol. xxv., p. 435.

† De Bary, "Comp. Morph. and Biol. Fungi, Mycet.," etc., p. 452.

plate and an indication of spindle-fibres converging at the poles; at a later stage the swarm-cell becomes ellipsoid and a constriction appears in the middle. As bipartition proceeds the nuclear plate divides and the two halves separate, the connecting achromatic fibres being often discernible. The daughter-nuclei at length retreat to the opposite poles of the swarm-cell, which in about a quarter of an hour from the beginning of the process of constriction is completely divided. A flagellum is in a short time produced by each daughter-cell, which then assumes the original form of the parent. After dividing in the manner described, through a period of uncertain duration, they withdraw the flagellum and creep with slow amœboid movement. When two of them come in contact with each other they may coalesce; others congregate at this point and form a centre to which great numbers converge, and though they may remain distinct for some time, ultimately unite and mingle into one moving mass, the plasmodium of Cienkowski. There is no doubt that the young plasmodia exercise a distinct attracting influence on the swarm-cells in their neighbourhood. Many amœboid swarm-cells, after remaining some time near the plasmodium, contract and form into microcysts, in which state they are enclosed by the plasmodium and become surrounded with vacuoles, where they are gradually digested. Although the fusing swarm-cells thus lose their individuality, their nuclei, so far as has been observed, remain distinct. For example, eight swarm-cells may be counted uniting and forming a plasmodium, and their eight nuclei can be afterwards distinguished; but when this number is exceeded the movements of the plasmodium and the inconspicuous nature of the nuclei present difficulties in the way of their recognition. Whatever reason there may be from general considerations to regard this fusion of individuals as akin to conjugation, no fusion of nuclei, which appears to be an essential part of the process, has yet been observed.

Fig. 3.—Didymium difforme Duby.

Young plasmodium, with attendant amœboid swarm-cells, some of which have turned into microcysts (*m*): one microcyst is being digested in a vacuole (*v*). An empty spore-shell is shown at *s*.

Magnified 470 times.

In the *Exosporeæ* represented by the single genus *Ceratiomyxa*, the spore is ellipsoid, and consists of granular protoplasm, in which four nucleus-like bodies can often be observed. This is enclosed by a membranous and colourless spore-wall. On placing the perfectly matured spores in pure water, the membranous

wall is seen almost immediately to slip free from the protoplasmic contents, often with a sudden jerk, and by this action may be removed to some distance from the now naked spore, while it retains its original form as an empty transparent sac.*

The naked spore remains from six to nine hours without any apparent alteration; at the end of this time a slow amœboid change of outline is observed, sometimes accompanied by the projection of numerous pointed pseudopodia, and a constriction begins to appear in the middle portion. As this continues, a second constriction can be noticed in each half. The first division may now become complete, but usually the whole of the spore contents remains united until a further constriction takes place in each quarter, and in about an hour from the time when the first movement was observed the original ellipsoid body is divided into eight spherical portions. These occasionally become free at this stage, but as a rule they continue attached to one another by narrow bridges; a few minutes later each protrudes a flagellum, and assumes the pyriform figure of a swarm-cell; then by the united lashing movement of their flagella the cluster of eight swarm-cells swims away. They may remain connected for an hour or more, but eventually become detached, and resemble in all respects the swarm-cells of the *Endosporeæ*.

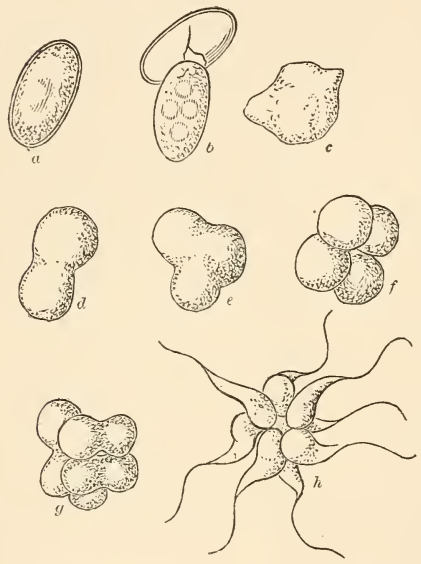

FIG. 4.—CERATIOMYXA MUCIDA Schroet.

a. Spore.
b. Spore-contents escaping from the spore-wall.
c to *g*. Successive stages in the division of the naked spore to eight.
h. Cluster of eight swarm-cells.
Magnified 1200 times.

The Plasmodium.—The phenomena which are met with in the swarm-cell may be seen in the plasmodium on an extended scale. Like the amœboid phase of the former, it is endowed with power of locomotion, and advances over the substratum with a creeping movement. The interior substance consists of granular proto-

* I have not observed the emergence of the spore-contents in an amœboid form through an opening of the spore-wall as described by Famintzin and Woronin, "Ueber *Ceratium hydnoides*, Mem. Acad. Petersbourg," xx. 3, 1873.

plasm, containing numerous nuclei and vacuoles. The latter vary in size, and are often seen to contract and discharge their contents, which is either watery or contains refuse matter. The movements in the interior of the swarm-cell are extended into a system of circulation in the plasmodium, which spreads in a network of veins with a few principal channels. Through these the granular substance streams in a rapid torrent which gradually comes to a pause in the space of a minute and a half to two minutes; it then immediately reverses its course, maintaining a rhythmic flow, backwards and forwards at nearly equal intervals, but always of a somewhat longer duration in the direction in which the plasmodium is creeping. This movement is continued through the smaller veins which branch with increasing intricacy till lost in the broad stratum ending at the tumid margin of the advancing wave. The whole is invested by a layer of hyaloplasm devoid of granular particles, but merging imperceptibly into the inner stratum. The hyaloplasm exhibits amœboid movements, projecting and withdrawing pseudopodia, and is unequal in thickness over different parts; it is generally abundant at the advancing margin, and a large residuum of substance free from granules and charged with refuse matter is left behind, marking the track where a plasmodium has passed. The hyaloplasm appears to be a more firm condition of the protoplasm assumed when exposed on the surface; how far it may have reference to the rhythmic streaming of the plasmodium, or what causes that movement, has not been ascertained.

The description given above applies to plasmodia which creep over dead leaves or the surface of logs or woody fungi. Those which inhabit the interior of rotten wood usually emerge only at the time of fruiting, and then appear as cushion-like masses or as scattered globules. The plasmodia of the *Calcareæ* contain granules of calcium carbonate (designated "lime"), in addition to the protoplasmic particles. The granules vary in abundance in different species, being small and inconspicuous under the microscope in some, while in the opaque white plasmodium of *Chondrioderma Michelii* they appear like crowded glass beads 2 μ or more in diameter, and greatly impede the streaming movement. The colour varies in different plasmodia; it is for the most part white, yellow, or pink, in some it is purple or green, but is generally constant in each species. An exception occurs in *Trichia fallax*, which usually rises from rotten wood in rosy pink globules, but frequently the plasmodium is watery white; the two colours are not met with together in the same growth, but the sporangia from each are identical in all characters. *Dianema depressum* has, as a rule, a white plasmodium, but occasionally it is pink.

De Bary states that "union never takes place between plasmodia of different species,"* and my own experience is in accord

* De Bary, *l.c.*, p. 426.

with this statement; the cases of hybridism referred to by Mr. Massee in his Monograph * appear to require confirmation.

The food of plasmodia is often easy to determine. Those which live among dead leaves spread with veins which are brown from the incorporation of decayed vegetable matter, and when the refuse is discharged they become white or yellow, according to the species, shortly before they form into sporangia. The plasmodium of *Badhamia panicea* thrives on the inner bark of felled elms, and is difficult to discern on the red-brown substratum owing to the broken fragments of bark with which it is densely charged; it becomes pure white by the rejection of enclosed matter before fruiting. Occasionally the question of food is somewhat obscure; for example, the plasmodium of *Amaurochæte atra* rises in cushions from half an inch to two inches in diameter, from the hard and apparently sound wood of Scotch firs; that of *Stemonitis splendens* may also be found emerging from the sawn surface of fir stumps, which show no sign of decay, and covering an area of six to seven square inches. Whatever solid matter these plasmodia may have ingested has been parted with before leaving the wood, but it appears more probable that their food was absorbed in a state of solution. The yellow plasmodium of *Badhamia utricularis* is the only one we are acquainted with which feeds on living fungi and is capable of being cultivated without limit on *Stereum hirsutum* and allied species; it can be observed under the microscope to dissolve fungus hyphæ as the hyaline border of a wave of plasmodium advances over them.† The growth of this species is often very rapid; a plasmodium measuring about a square inch in area on a large pileus of *Auricularia mesenterica* has been seen to increase during twenty hours so as to cover more than six square inches; the vigorous flow extended over the meshes between the veins and produced an unbroken surface.

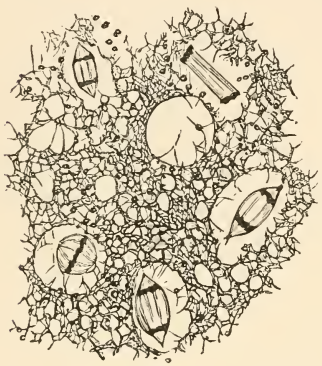

FIG. 5.—BADHAMIA UTRICULARIS Berk.

Division of nuclei by karyokinesis in the streaming plasmodium.

From a preparation stained in safranin, and mounted in Canada balsam.

Magnified 1200 times.

The multiplication of nuclei which takes place in such a growth as this, where we may assume, from numerous observations, that they have increased at least sixfold, requires further investigation. That they sometimes divide by karyokinesis is

* Mass., *Mon.*, p. 15.

† Lister, "Plasmodium of Badhamia," etc., *Annals of Botany*, vol. ii., 1888, p. 13.

proved by the case described by me in *Journ. Linn. Soc.*, vol. xxix., p. 541. In that instance a plasmodium of *B. utricularis* growing on *Auricularia mesenterica* partly spread in a network of veins over two large coverslips; the films were killed with Flemming's fluid, stained with safranin, and mounted in Canada balsam. In these two preparations the nuclei are seen to be dividing by karyokinesis; the stages represented are the nuclear spindle, and where the nuclear plate has divided and the two halves are connected by achromatic fibres. Part of the same plasmodium spread over another coverslip, and was killed and stained with the others. The nuclei in this preparation have the appearance most commonly met with, containing a central nucleolus, and without any indication of karyokinetic division. The main body of the plasmodium continued to creep over the *Auricularia* for several days after these observations had been made.

This experiment affords clear evidence that under certain conditions the nuclei of the actively streaming plasmodium divide by karyokinesis, but what these conditions are remains at present unexplained. The process no doubt is a rapid one, occupying about half an hour; but the following observations confirm the conclusion arrived at from many previous experiments, that it is not the only way by which the nuclei increase in number. A further growth of the plasmodium already referred to as increasing sixfold in twenty hours, spread over two pilei of *Auricularia* in the course of fourteen hours; during this period a portion of the plasmodium was taken every quarter of an hour, and smeared on a thin coverslip and stained. Each of the fifty-five mountings shows the nuclei in the usual vast abundance, implying that their numbers had increased, *pari passu*, with the growth of the plasmodium, and in none of them is there any appearance of karyokinetic division. From previous observations of the length of time occupied by the karyokinetic process we are satisfied that it could not have escaped detection if it had occurred during those fourteen hours. The multiplication of nuclei which we are bound to assume had taken place must therefore have been produced by some other means. They vary in size from 2·5 to 5 μ, and the great majority contain a single sharply defined and deeply stained nucleolus, which is seen to be connected with the nuclear-wall by delicate threads.

Fig. 6.—Badhamia utricularis Berk.

Group of nuclei from actively feeding plasmodium that covered two pilei of *Auricularia* in fourteen hours, showing the irregular size of the nuclei and large nucleoli. Stained in picro-carmine and mounted in Canada balsam. Magnified 1200 times.

In a few instances a large nucleus encloses two nucleoli, and occasionally there are appearances which strongly suggest that simple division of a nucleus is taking place. Some days later, when the plasmodium had ceased to feed, and was collecting together to form into sporangia, stainings showed the nuclei more equal in size, measuring 4 to 5 μ in diameter. This experiment may be taken to add materially to the negative evidence, to say no more, that under some conditions the increase in the number of the nuclei is produced by simple division.

The plasmodium of the exosporous *Ceratiomyxa* issues from the interior of rotten wood to form cushion-like heaps which rapidly extend into columnar or branching sporophores. As the streaming movement common to both divisions of the Mycetozoa is not described by Famintzin and Woronin in their valuable paper on *Ceratiomyxa* before alluded to, the following observations may be given. Rounded cushions of plasmodium were placed on a cover-slip, supported at the margins by wet blotting-paper, and were thus enclosed in a moist chamber. The plasmodium spread in a film over the glass, and here eventually an abundant growth of spores was produced. At the earliest stage that could be observed under the microscope the plasmodium was seen to be sharply differentiated into two elements—a hyaline part which ultimately forms the principal constituent of the gelatinous column, and the granular protoplasm containing numerous small nuclei. In the film on the cover-glass the granular substance spread in a network of veins through the hyaline portion. Through these veins the protoplasm streamed in rhythmic flow, first in one direction and then in the other, at the same intervals of time as in the *Endosporeæ*.

The Sclerotium.—Superficial plasmodia may pass into the resting stage or sclerotium, and this change may be induced by exposure to dry air. In some cases, however, it occurs when water and apparently food material are present, and the cause for the change is then difficult to discover. When the plasmodium of *Badhamia utricularis* is dried, the streaming movement gradually ceases, and the granular particles collect in clusters, surrounded by a border of hyaloplasm; the refuse matter is thrown out, and a membranous cyst-wall forms round each cluster of granules, which also includes 10 to 20 nuclei; the cysts become agglomerated into thick masses of irregular shape, drying to a horny consistence.* The changes of outline seen in the maturing sclerotia cannot be merely the effect of shrinking from drying, and as under the microscope we frequently observe the cysts along the margin of a forming sclerotium creep among each other with amœboid movement, it is probable that this movement takes place throughout the mass. The sclerotium of this species can be revived after preservation in a dry state for three years, by

* Lister, "On Plasmodium of Badhamia and Brefeldia," *Ann. Bot.*, vol. ii., 1888, p. 13.

being placed in water; that which has been lately formed resumes the streaming condition in a few hours; when of greater age it requires to be kept wet for some days before the movement begins; the cyst-walls are then absorbed, and their contents coalesce. It frequently happens that parts of old sclerotia are incapable of resuscitation, but they afford a pabulum for the newly awakened plasmodium, through whose veins the cysts may be seen to be carried along and broken up. The sclerotium of *Didymium effusum* is sprinkled over with a deposit of crystals of lime, and after being revived the cyst-walls are not dissolved, as in *Badhamia*, but remain as empty hyaline sacs when the contents has crept out. The formation of sclerotia in plasmodia inhabiting the interior of rotten wood is less easy to follow, but it is probably of frequent occurrence. A plasmodium of *Stemonitis fusca*, cultivated from spores in a moist chamber, passed into the resting state a few days after it had formed, spreading in a single layer of crowded cysts on the surface of the glass. This sclerotium was dried and re-wetted, when it revived, and the cyst-walls were dissolved; the cultivation was conducted with pure water, with no attempt to supply nourishment, and the plasmodium returned to the encysted condition in about twenty-four hours; it was again dried and again revived, but afterwards it reassumed the sclerotium state, from which it could not be reawakened.

The *Sporangium* and *Sporophore*. — The formation of the sporangium in the *Endosporeæ* has been minutely described by de Bary,* and only a brief notice of the general characters will be sufficient here. The plasmodium concentrates at certain points and developes into sporangia of the various forms which will be found described in the account of each species; they are either simple, though often densely clustered, or they are combined into an *æthalium*, a cushion-like structure consisting of numerous convoluted or imperfectly-defined sporangia. The simple forms are either symmetrical, with or without a stalk, or they are unsymmetrical, spreading on the substratum with an irregular outline, when they are called *plasmodiocarps*. In most cases the shape of the sporangium is nearly constant, while in others it is subject to much variation. Two abundant species, *Physarum nutans* and *Didymium effusum*, may be mentioned as examples of variable habit; in each of them we often find vein-like plasmodiocarps and symmetrical sporangia both stalked and sessile, resulting from the same plasmodium. It is true of the shape of the sporangium, as it is of the size of the spores and the form and colour of the capillitium, that though a valuable guide, it cannot be taken as supplying a rigid specific character, and the want of a sufficient series of specimens showing how widely a species may vary, has led to the multiplication of names without adequate grounds.

* De Bary, *l.c.*, p. 424.

In examining the rising sporangia of *Physarum nutans* in a moist chamber under the microscope, the projecting masses of plasmodium are seen to pulsate, distending and shrinking as the rhythmic flow advances or retreats, but gradually gaining with the advancing movement. The basal part of each contracts and forms a stalk consisting of a tube of tougher hyaline substance through which the protoplasm continues to pass until the surrounding veins have emptied their contents into the spherical sporangium. The coarse refuse matter which has not been discharged along the track of the plasmodium, where it often takes the form of a hypothallus connecting the sporangia, is deposited in the centre of the stalk. When the young sporangium has attained its full dimensions, the wall thickens, and a part of the lime granules which abounded in the plasmodium is incorporated in the wall-substance; the remaining part is collected into the *lime-knots* or vesicular swellings of the hyaline threads of the capillitium; these threads branch and anastomose, forming a network which spreads through the spore-plasm from the base of the sporangium to its wall. The formation of spores takes place after the capillitium has been developed in all the genera which are characterised by its presence. In *Didymium* the lime-granules which can be seen in the plasmodium are dissolved in the sporangium, and the salt in solution passes through the soft sporangium-wall and forms into crystals on the outer surface. The various kinds of capillitium represented in the different genera and species are described in the text. The formation of spores in the *Endosporeæ* is preceded by the division of the nuclei in the spore-plasm by karyokinesis. The process was first recorded by Strasburger as occurring in *Trichia fallax*.* Recent observations show that this mode of nuclear division takes place in the sporangium only once, and occurs almost simultaneously in all the nuclei rather more than an hour before the spores begin to be

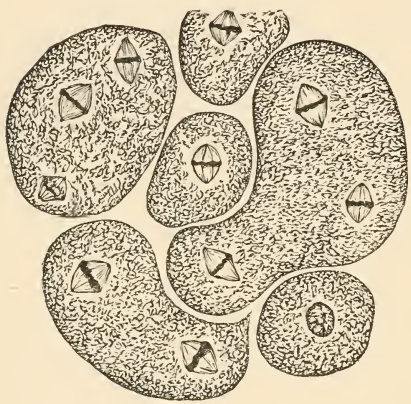

FIG. 7.—COMATRICHA OBTUSATA Preuss.

From a stained preparation of a young sporangium, showing the plasmodium separated into rounded masses about groups of nuclei, which are dividing by karyokinesis; the nuclear division has reached the "spindle stage"; the spindles are seen in profile in all cases but one in which the equatorial plate is seen from one of the poles of the spindle.
Magnified 1200 times.

* *Botanische Zeitung*, May 1884.

formed. The chromatin constituents of the nucleus first show a coarser arrangement, which is followed by the "spindle stage," exhibiting an equatorial plate with achromatic fibres converging at the poles. In *Badhamia*, *Physarum*, *Craterium*, *Didymium*, *Stemonitis*, *Lamproderma*, and *Comatricha* the plasma at this period breaks up into lobed masses containing six to ten nuclei; the equatorial plate of each nuclear spindle now divides horizontally, and as the two halves draw apart the lobed masses of plasma undergo a further division, until the time when the daughter-nuclei have widely separated. Though still connected by achromatic fibres, each pair is enclosed in a portion of plasma of the capacity of two spores; these portions become constricted into the ultimate spores, each containing a single nucleus: in a short time the spore wall is acquired, and the active stage of the organism comes to a close. In the genera just mentioned, spore-formation occurs in warm weather about twenty hours after the sporangia have taken form. In *Trichia* the interval is much longer, extending from two to four days according to the temperature. In this genus and also in *Arcyria*, *Lycogala*, and *Reticularia Lycoperdon*, the spore-plasm is not seen to separate in lobed masses at the time when the nuclear spindle is formed, but the karyokinetic process is completed and the daughter-nuclei are definitely parted from one another before the plasma breaks up and encloses each nucleus in a young spore.*

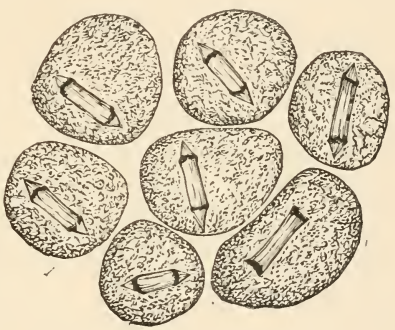

FIG. 8.—COMATRICHA OBTUSATA Preuss.

From a stained preparation of a young sporangium, showing the plasmodium separated into masses of two spores' capacity round the nuclei, which have almost divided by karyokinesis. Magnified 1200 times.

The sporophores of *Ceratiomyxa* are columnar, or confluent and interlacing. In their early stage the protoplasmic matter spreads throughout the superficial part of the columns, and also in numerous veins traversing the watery gelatinous interior substance. These veins are ultimately withdrawn to the outer layer, which divides into polyhedral portions of equal size, giving an areolated structure to the even periphery; each portion contains a single nucleus 2·5 μ in diameter. The whole sporophore is invested by a thin hyaline layer. The material of this investing layer and the interior gelatinous substance take a bright red colour in preparations stained in picrocarmine, which contrasts with the yellow tint of the protoplasmic matter. The contents of

* Nuclear division is observed by taking stainings, at short intervals, of the contents of groups of sporangia which have risen together at one time; further details are given in *Linn. Soc. Journ.*, vol. xxix., p. 529.

each areola now rises in a shortly cylindrical projection from the surface of the sporophore, carrying with it a hyaline investment, which becomes constricted at the base of the cylindrical process. This constriction is continued until an elongated membranous stalk is formed, bearing at its apex a globule containing the protoplasmic matter with its nucleus. The contents of the globule develops in the course of a few hours into the ellipsoid spore; this is enclosed in a membranous wall, and is easily detached from the stalk. The gelatinous sporophore dries to a membrane of the frailest structure, and disappears with the first shower of rain. The process by which the eight swarm-cells derive their nuclei from the single nucleus of the areolar space of the sporophore has not been followed; but, judging from analogy, we conclude that a succession of divisions took place from the original nucleus. It appears uncertain how far the changes met with in the sporophores of *Ceratiomyxa* have an exact parallel in what is seen in the development of the sporangia of the *Endosporeæ*. Taking the sporophore as representing the sporangium, we have in both cases a structure developing from the plasmodium and consisting of supporting elements and spore-plasm. In all the *Endosporeæ*, so far as has been observed, the nuclei divide by karyokinesis shortly before the spores are formed, and this division is accompanied in many instances, as before mentioned, by the lobing of spore-plasm into masses of two spores' capacity round the dividing nucleus. If the stalked bodies formed on the surface of the sporophore correspond with the spores of the *Endosporeæ*, we should expect a previous karyokinetic division of nuclei to have taken place; a process which has hitherto, however, escaped detection in stained preparations. We should then view the division of the spore-contents of *Ceratiomyxa* into eight swarm-cells, as corresponding with a series of multiplications of a swarm-cell of the *Endosporeæ* with arrested cell-division. But the whole process requires further careful investigation, and, with the facts already in our possession, there are two other hypotheses which may be suggested as possible. The areolæ of the sporophore may represent the masses of two spores' capacity present round the dividing nucleus in many of the *Endosporeæ*; but in this case the masses become encysted and stalked, nuclear division is deferred until the cysts are fully formed, and it is not until these have been placed in water that the cyst-wall is thrown off and the contents divided into eight naked spores. A third and widely different view takes what have commonly been regarded as equivalent to spores in *Ceratiomyxa* as representing stalked sporangia, arising in great numbers and regularity from the surface of the gelatinous body, which corresponds to a branched and complex hypothallus. Each sporangium, which at first contains a single nucleus, on being placed in water throws off its sporangium-wall and divides into eight naked spores.

Should either of the two latter views prove to be the true one, the definition of the *Mycetozoa* would require to be modified, for the rhythmic streaming of its plasmodium and the character of its

swarm-cells show that *Ceratiomyxa* belongs in essential points to the *Mycetozoa*, but with modifications in the intermediate stages of development.

As has been stated before, many species of the *Mycetozoa* are associated with numerous varieties, using the word *species* as a name given for the convenience of classification to a form possessing definite and permanent characters which distinctly separate it from any other; and the word *variety* to such as are linked with the type by a close series of connecting forms, and although more or less stable, do not possess such distinctive characters as would render it expedient or helpful to mark them with specific rank.

The geographical distribution of most of the species is very wide, and the main characters are remarkably constant in specimens gathered in all parts of the world.

Specimens of *Hemitrichia clavata*, *H. Serpula*, *Dictydium umbilicatum*, and *Trichia fallax*, obtained from Europe, India, and North and South America, are identical to the most minute microscopic detail; and numerous other equally stable forms might be cited. On the other hand, the American and tropical species of the genus *Cribraria* are more elegant in form than individuals of the same species here and on the Continent, and most of them show a tendency, in the great regularity of their structure, towards the type of *C. intricata*, a striking and well-marked species which is abundant in those regions, but rare in our less brilliant atmosphere. The genus is largely represented in America, and intermediate forms between the recognised species are frequent; some of these are described by Dr. Rex in letters to me as being constant in gatherings from several States, but they are so closely allied to established types that he hesitates to give them separate specific names. The more elegant growth in the American species is not confined to the genus *Cribraria*, but is of general occurrence; and it is probable that the slight modification of the prevailing type is due to the influence of climate. This is what might be looked for when we consider the effects which changes of weather produce in the development of sporangia in this country. On old decaying stumps which can be kept under observation for several years, we may have growths of *Trichia affinis*, which year after year present the same typical characters, only differing in the elaters in one season being slightly thicker than those in another. When cold weather sets in while the plasmodium is rising, the arrangement of the spiral bands is so abnormal as to suggest a marked variety, but with a return of milder weather the original form reappears, leaving no doubt that all have been derived from a common parentage. Developments of *Trichia persimilis* of the typical form have been followed after a few nights' frost by a growth in which the short and nearly smooth elaters closely resemble those of *Oligonema nitens*, though the spores and the shape of the sporangia retain the normal character. *T. scabra*

may exhibit a *Hemitrichia*-like capillitium; and a specimen of *Hemitrichia Serpula* from New Zealand, which has the appearance of having been affected by weather at the time of development, has a part of the capillitium consisting of short fusiform elaters. In some extensive gatherings of *Trichia affinis* which have matured in hot, dry weather, the elaters are so reduced in size as scarcely to exceed the diameter of a spore in length, though the sporangia are perfectly normal in form, and the spores are marked with the typical sculpture. In *Stemonitis*, *Lamproderma*, *Prototrichia*, and other genera, great variations are caused by changes of temperature; but in none of these cases which have come under my observation is there any indication of a transition from one species to another. An interesting account is given by Dr. Rex of a remarkable and abnormal development of *Stemonitis splendens*, referred to under the description of that species in this work, where, through successive generations, a gradual return took place to the normal type. In this instance other causes than change of temperature must have taken part.

Although the search for specimens of the Mycetozoa has been comparatively limited, owing, no doubt, to the small size of the objects, yet in consequence of the persistent nature of the sporangia, we possess, in the different herbaria, specimens representing the gatherings from many countries during more than half a century, and some of them dating back to nearly a hundred years. Where they have escaped rough treatment, they completely retain their specific characters. In reviewing these specimens one is struck with the completeness of the group and the general stability of the species; and when we consider their cosmopolitan distribution, owing, we may conclude, to the long-continued vitality and minuteness of the spores, it may be doubted whether any hitherto unsearched region will add very largely to the number of species with which we are already acquainted. It is their life history which is at present imperfectly known, and it is in this direction that the important work of the future must lie.

The affinities of the *Mycetozoa* have been dealt with by de Bary and Zopf in the works before referred to.

It had been suggested that they were allied to the fungi through the *Chytrideæ*, which do not always form a mycelium, and in which the entire vegetative body is finally transformed into a many-spored sporangium, the vegetative body and spores having the power of amœboid movement for a longer or shorter time. De Bary, however, mentions among other points of difference that the *Chytrideæ* do not form a plasmodium by the coalescence of swarm-cells, "and there is therefore no ground for assuming their direct relationship with the Mycetozoa." *

The position of the *Acrasieæ* in which the swarm-cells exhibit

* De Bary, *l.c.*, p. 445.

amœboid movements, but do not produce a flagellum, and aggregate without coalescing into a true plasmodium, has already been referred to (p. 1). The view held by de Bary that the *Mycetozoa* are more closely associated with the *Protozoa* is supported by a comparison with the pelagic *Protomyxa* of Haeckel, which is stated to develop a plasmodium by the coalescence of swarm-spores, and differs from the *Mycetozoa* chiefly in the absence of a firm spore membrane;* also by comparison with *Bursulla*, which, according to Sorokin, forms a true plasmodium and minute sporangia on horse dung; the spores do not become invested with a firm membrane, and escape from the swollen apex of the sporangium in the form of swarm-cells, without cilia, but capable of amœboid movement.† Zopf extends the *Mycetozoa* so as to embrace the *Monadineæ* of Cienkowski, but de Bary maintains that whatever may be the points of agreement between the *Monadineæ* and the *Mycetozoa* they are not such as to warrant their being classed with the latter division as defined by himself.‡ Lankester accepts the group as defined by de Bary, and places them in his grade *Gymnomyxa* of Protozoa; he suggests their affinity with the *Sporozoa*.§

The ingestion of bacteria by the swarm-cells appears to strengthen the view that the group is more nearly associated with the lower forms of animal than of vegetable life, and the name of *Mycetozoa* appears to mark its true position in the borderland between the two kingdoms. For a more complete discussion of this subject I must refer to those who have paid special attention to the allied groups.

In preparing this catalogue of the collection of *Mycetozoa* in the British Museum, the arrangement of orders and genera given by Rostafinski in his Monograph‖ has been mainly followed, with such alterations as observations made during recent years have rendered necessary. De Bary made the group the subject of minute and thorough investigation;¶ and Rostafinski, while studying under him at Strassburg, devised a system of classification which is clear and comprehensive, and is now generally accepted.

The division by Rostafinski of the main section *Endosporeæ* into two parts, distinguished by the colour of the spores, has been objected to as being artificial and wanting in universal application, but the cases in which species offer difficulty with regard to their position under this scheme are few, and on the whole the organisms range themselves under the separate heads in a remarkably natural manner, while for determining the species the plan is simple and convenient.

* De Bary, *l.c.*, p. 449.
† *Ibid.*, p. 446.
‡ *Ibid.*, p. 443.
§ Zoological Articles, 1891, pp. 11, 26.
‖ Sluzowce (Mycetozoa) Monographia (Paris: 1875).
¶ Comp. Morph. and Biol. Fungi, Mycetozoa, etc., p. 421.

In this catalogue the descriptions of the different species given in the text are taken from specimens I have personally examined; a list is appended at the end of each genus of such as are not represented in the collections to which I have had access, and in these cases the definitions are copied from the books in which they are described. I am far from supposing that my work is free from inaccuracy, but every species of which I have given the characters can be examined, either in bulk or as a mounted object, in the British Museum collection. The specimens I have supplied to supplement the collection are indicated in the following pages under each species by the letters L.B.M.

The rules which govern the nomenclature of species, laid down by Alph. de Candolle, "Laws of Botanical Nomenclature" (1868), and adopted by botanists, require that the first authentic specific name published under the genus in which the species now stands shall take precedence of all others. Compliance with this direction has occasioned considerable alteration of the names given in Rostafinski's Monograph, in which work a severe attention to this important principle has not been observed. I am greatly indebted to Mr. Carruthers, who, in addition to other valuable assistance, has traced the history of each species in the volumes of the British Museum Library, and made the necessary corrections.

I offer my grateful acknowledgments to those through whose courtesy I have been enabled to study the various herbarium specimens that have come under my notice; to the Director of the Royal Gardens at Kew for giving me special facilities for investigating the collection under his care, which includes Berkeley's precious series, containing a great number of original types from India, New Zealand, and America that supplied Rostafinski with a large part of the material introduced into the Appendix to his Monograph. These types are to a large extent duplicated in Broome's and Ravenel's collections in the British Museum. To Professor Bayley Balfour I return my thanks for much friendly assistance and for the opportunity of inspecting the specimens in the Royal Herbarium at Edinburgh, including Greville's collection and an almost complete set of type examples supplied by the late Professor de Bary; to Professor van Tieghem for the inspection of the collection of the Paris Museum; to Professor A. Blytt for an opportunity of examining the most important types in the Museum at Christiania; to Dr. Boerlage for giving me access to the Leyden collections; and especially to Graf zu Solms-Laubach for the privilege afforded me of inspecting de Bary's invaluable collection at Strassburg, containing a large proportion of the type specimens referred to by Rostafinski in his original Monograph; to Dr. Rex, of Philadelphia, for a nearly complete series of the species found in the United States of America, now represented in the British Museum collection, and for the communication of his views on a group to which he has devoted many years of careful research. I am also grateful to my friend Professor Farlow for many valuable speci-

mens and useful suggestions; and to Professor Macbride, of Iowa, and Mr. Morgan, of Ohio, for a fine series of the *Mycetozoa* from their respective districts; also to Dr. Haviland for specimens of great interest from Borneo. Mr. Camm, of Smethwick, and Mr. Saunders, of Luton, have supplied me with many scarce British species; and to Mr. Phillips and Mr. Massee I am obliged for kindly entrusting me with their collections for examination.

The Plates in this work are collotype reproductions of water-colour drawings made under the camera-lucida and reduced to half the originals; the descriptions of the spore sculpture in the text must therefore be understood as giving the appearance when magnified 1200 diam., Zeiss $\frac{1}{15}$th obj.

I have further to mention that throughout my studies of the Mycetozoa, and in the preparation of the drawings illustrating this work, I have had the assistance of my daughter, Gulielma Lister.

SYNOPSIS OF THE ORDERS AND LIST OF THE GENERA OF THE MYCETOZOA.

Subclass I.—EXOSPOREÆ. Spores developed outside the sporophores. (P. 25.)

Order I. — CERATIOMYXACEÆ. Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolated sporophore (P. 25.)

Genus 1. *Ceratiomyxa* Schroeter. (P. 25.)

Subclass II.—ENDOSPOREÆ. Spores developed inside the sporangium. (P. 26.)

Cohort I.—*AMAUROSPORALES.* Spores violet, or violet-brown, except in *Stemonitis* and *Comatricha*, in a few species of which they are pale ferruginous. (P. 26.)

Subcohort I.—*CALCARINEÆ.* Sporangia provided with lime (calcium carbonate). (P. 26.)

Order I.—PHYSARACEÆ. Lime in minute innate granules. (P. 26.)

Genus 2. *Badhamia* Berk. (P. 29.)
3. *Physarum* Pers. (P. 37.)
4. *Fuligo* Haller. (P. 65.)
5. *Cienkowskia* Rost. (P. 68.)
6. *Physarella* Peck. (P. 68.)
7. *Craterium* Trent. (P. 69.)
8. *Leocarpus* Link. (P. 75.)
9. *Chondrioderma* Rost. (P. 75.)
10. *Trichamphora* Jungh. (P. 89.)
11. *Diachæa* Fries. (P. 90.)

Order II.—DIDYMIACEÆ. Lime in crystals. (P. 93.)

Genus 12. *Didymium* Schrad. (P. 93.)
13. *Spumaria* Pers. (P. 104.)
14. *Lepidoderma* de Bary. (P. 105.)

Subcohort II.—*AMAUROCHÆTINEÆ.* Sporangia without lime. (P. 108.)

Order I.—STEMONITACEÆ. Sporangia simple. (P. 108.)

Genus 15. *Stemonitis* Gled. (P. 109.)
16. *Comatricha* Preuss. (P. 116.)
17. *Enerthenema* Bowm. (P. 124.)
18. *Lamproderma* Rost. (P. 125.)
19. *Clastoderma* Blytt. (P. 132.)

Order II.—Amaurochætaceæ. Sporangia combined into an æthalium. (P. 134.)

Genus 20. *Amaurochæte* Rost. (P. 134.)
21. *Brefeldia* Rost. (P. 135.)

Cohort II.—*LAMPROSPORALES.* Spores variously coloured, never violet. (P. 136.)

Subcohort I.—*ANEMINEÆ.* Capillitium wanting, or not forming a system of uniform threads. (P. 136.)

Order I.—Heterodermaceæ. Sporangium-wall membranous, beset with microscopic, round granules, and (except in *Lindbladia*) forming a net in the upper part. (P. 136.)

Genus 22. *Lindbladia* Fries. (P. 137.)
23. *Cribraria* Pers. (P. 138.)
24. *Dictydium* Schrad. (P. 148.)

Order II.—Liceaceæ. Sporangium-wall cartilaginous; sporangia solitary. (P. 149.)

Genus 25. *Licea* Schrad. (P. 150.)
26. *Orcadella* Wing. (P. 152.)

Order III.—Tubulinaceæ. Sporangium-wall membranous, without granular deposits; sporangia tubular, compacted. (P. 152.)

Genus 27. *Tubulina* Pers. (P. 153.)
28. *Siphoptychium* Rost. (P. 155.)
29. *Alwisia* Berk. & Br. (P. 155.)

Order IV.—Reticulariaceæ. Sporangia combined into an æthalium, the sporangium-wall incomplete, perforated or forming a spurious capillitium. (P. 156.)

Genus 30. *Dictydiæthalium* Rost. (P. 157.)
31. *Enteridium* Ehrenb. (P. 158.)
32. *Reticularia* Bull. (P. 160.)

Subcohort II.—*CALONEMINEÆ.* Capillitium present, a system of uniform threads. (P. 161.)

Order I.—Trichiaceæ. Capillitium consisting of free elaters, or combined into an elastic network with thickenings in the form of spirals or complete rings. (P. 161.)

Genus 33. *Trichia* Haller. (P. 163.)
34. *Oligonema* Rost. (P. 173.)
35. *Hemitrichia* Rost. (P. 174.)
36. *Cornuvia* Rost. (P. 181.)

Order II.—Arcyriaceæ. Capillitium combined into an elastic network with thickenings in the form of cogs, half rings, spines,

or warts (scanty and often reduced to free threads in *Perichæna corticalis*). (P. 182.)

Genus 37. *Arcyria* Hill. (P. 183.)
38. *Lachnobolus* Fries. (P. 194.)
39. *Perichæna* Fries. (P. 195.)

Order III.—Margaritaceæ. Capillitium not consisting of free elaters, nor combined into an elastic network. (P. 202.)

Genus 40. *Margarita* Lister. (P. 202.)
41. *Dianema* Rex. (P. 204.)
42. *Prototrichia* Rost. (P. 206.)

Order IV.—Lycogalaceæ. Sporangia forming an æthalium, capillitium consisting of smooth or wrinkled branching colourless tubes. (P. 207.)

Genus 43. *Lycogala* Mich. (P. 207.)

MYCETOZOA de Bary.

Subclass I.—EXOSPOREÆ. Spores developed outside the sporophores.

Order I. — CERATIOMYXACEÆ. Sporophores membranous, branched; spores white, borne singly on filiform stalks rising from the areolated sporophore.

Genus 1.—**CERATIOMYXA** Schroeter, in Engl. and Prantl, Nat. Pflanzenfam., i., 1, p. 16 (1889). Sporophores consisting of membranous processes, either simple branches from a common base, or forked, or forming a network. The periphery is mapped out into polyhedral areolæ, from the centre of each of which arises a slender stalk bearing a single ellipsoid colourless spore.—*Ceratium* Alb. & Schw., Consp. Fung., p. 358 (1805) non Schrank (1793).

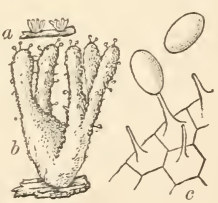

Fig. 9.

Fig. 9.—*Ceratiomyxa mucida* Schroet.

a. Clusters of sporophores. Twice natural size.
b. Sporophore. Magnified 40 times.
c. Four areolæ of mature sporophore: one spore still attached to its stalk, and another free. Magnified 480 times.

1. **C. mucida** Schroet., l.c. Plasmodium colourless. Sporophores white or pinkish-yellow, membranous, either rising from a common hypothallus in a tuft of simple or forked, fasciculate obtuse branches, 1 mm. or more high, ·07 mm. thick, or more or less interwoven in broad perforated bands, from which arise irregular and anastomosing lobes; the membranous wall is divided, chiefly on the upper part of the sporophore, into somewhat hexagonal areolæ about 10 μ broad; a membranous stalk bearing the spore arises from the centre of each areola. Spores white smooth ovoid, 10 × 6 to 13 × 7 μ.—Macbride, in Bull. Nat. Hist. Iowa, ii., p. 114. *Isaria mucida* Pers., in Römer, N. Mag. Bot., i., p. 121 (1794). *Ceratium hydnoides* Alb. & Schw., Consp. Fung., p. 358. Fr., Syst. Myc., iii., p. 294; Fam. & Wor., in Mem. Acad. Imp. Petersb. (1873), Ser. 7, xx., p. 4; Zopf, Pilzthiere, pp. 64, 174; de Bary, Comp. Morph. Fungi (1887), p. 432; Eng. Fl., v., p. 329; Cooke, Brit. Fungi, ii., p. 550. *Ceratium pyxidatum* Alb. & Schw., *l.c.*, p. 359. *Ceratium arbuscula* Berk. & Br., in Journ. Linn. Soc., xiv., p. 97.

The sporophores are subject to much variation in form, and may all be either white or pinkish-yellow.

α. **genuina**: branches of sporophores short, free.

β. **flexuosa**: sporophores consisting of a loose flexuose system of slender white threads, profusely branching but not anastomosing, and averaging about ·02 mm. in diameter, increasing to 0·5 mm. at the base, the ultimate branchlets somewhat clavate. In other characters this corresponds with the type.—*Ceratium filiforme* Berk. & Br., in Journ. Linn. Soc., xiv., p. 97.

γ. **porioides**: differs from the type only in the dense arrangement of the sporophores. As intermediate forms occur which unite it with the type, I cannot consider it specifically distinct. Superficially it suggests the appearance of *Polyporus vulgaris*, though much more minute.—*Ceratium porioides* Alb.& Schw.,Consp. Fung., p. 359; Fr., Syst. Myc., iii., p. 295; Fam. & Wor., in Mem. Acad. Imp. Petersb., Ser. 7, xx., p. 5; Zopf, Pilzthiere, pp. 64, 174.

Plate I., A.—Fig. *a.* var. *genuina*: sporophores, × 20 (England); *b.* spores of the same, × 600; *c.* sporophores of a form approaching var. *porioides*, × 20 (England); *d.* var. *flexuosa*: sporophores, × 20 (Borneo); *e.* clavate end of sporophore of the same (all the spores but one have fallen from their stalks), × 280.

Hab. Plasmodium in rotten wood, fruiting on the outside.—*a.* Lyme Regis, Dorset (L:B.M.1); Iowa (L:B.M.1). *a.* and *β.* Borneo (L:B.M.1). γ. Carlsruhe (Strassb. Herb.); Upsala (L:B.M.1); Iowa (B.M. 1025).

Subclass II.—ENDOSPOREÆ. Spores developed within the sporangia.

Cohort I.—*AMAUROSPORALES.* Capillitium always present. Spores violet or violet-brown, but pale ferruginous in a few species of *Stemonitis* and *Comatricha.*

Subcohort I.—*CALCARINEÆ.* Deposits of lime in minute granules, innate in the sporangium-wall or compacted in the knots of the capillitium or in the stalk, or in crystals over the sporangium-wall.

Order I.—PHYSARACEÆ. Deposits of lime in minute granules, more or less aggregated, not in crystals (except partially in *Chondrioderma Trevelyani*), innate in the sporangium-wall, and in vesicular expansions of the capillitium (= lime knots), except in *Chondrioderma* and *Trichamphora*, where there are no lime knots, and in *Diachæa*, in which the lime is confined to the stalk and columella. Sporangia simple except in *Fuligo*, where they are combined into an æthalium.

KEY TO THE GENERA OF *PHYSARACEÆ*.

A. Capillitium a coarse network charged with lime throughout.
(2) BADHAMIA.

Fig. 10.

Fig. 10.—*Badhamia utricularis* Berk.
a. Cluster of sporangia. Magnified 3½ times.
b. Fragment of capillitium and spore-cluster. Magnified 140 times.

B. Capillitium a delicate network of threads with vesicular expansions filled with lime-granules (= lime-knots).
A. Sporangia combined into a convolute æthalium.
(4) FULIGO.

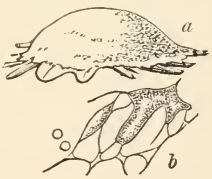

Fig. 11.

Fig. 11.—*Fuligo septica* Gmel.
a. Æthalium. One-third natural size.
b. Capillitium threads with lime-knots and two spores. Magnified 120 times.

B. Sporangia single, scattered or aggregated.
a. Sporangium-wall membranous, with innate lime-granules either in clusters or compacted and chalky. Sporangia subglobose or plasmodiocarps.
(3) PHYSARUM.

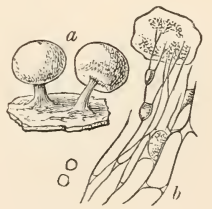

Fig. 12.

Fig. 12.—*Physarum nutans* Pers.
a. Two sporangia. Magnified 9 times.
b. Capillitium threads, with lime-knots, attached to a fragment of the sporangium-wall. Magnified 110 times.

Sporangia tubular, stalked. (6) PHYSARELLA.

Fig. 13.

Fig. 13.—*Physarella mirabilis* Peck.

Two sporangia, one perfect, the other dehiscing in revolute lobes from the funnel-shaped columella. Magnified 6½ times.

b. Sporangium-wall cartilaginous throughout or at the base.

Sporangia plasmodiocarps, capillitium with free hooked branches. (5) CIENKOWSKIA.

Fig. 14.

Fig. 14.—*Cienkowskia reticulata* Rost.

a. Part of branching plasmodiocarp. Magnified 4 times.

b. Capillitium threads and part of a perforated lime-plate. Magnified 140 times.

Sporangia goblet-shaped with a lid of thinner substance, or subglobose and rugose. (7) CRATERIUM.

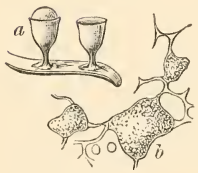

Fig. 15.

Fig. 15.—*Craterium vulgare* Ditm.

a. Two sporangia; in one the lid has fallen away. Magnified 10 times.

b. Capillitium with lime-knots and two spores. Magnified 110 times.

Sporangia ovoid, shining as if varnished. (8) LEOCARPUS.

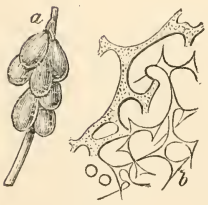

Fig. 16.

Fig. 16.—*Leocarpus vernicosus* Link.

a. Cluster of sporangia. Magnified 2½ times.

b. Hyaline threads and branching lime-knot of the capillitium, with two spores. Magnified 120 times.

C. Capillitium without lime-knots.

Sporangium-wall of two layers more or less combined. (9) CHONDRIODERMA.

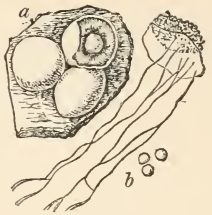

Fig. 17.

Fig. 17.—*Chondrioderma testaceum* Rost.

a. Group of three sporangia; in the upper one the double wall is broken away in part and the columella exposed. Magnified 9 times.

b. Portion of the outer and inner layers of the sporangium-wall; to the latter the capillitium threads are attached: three spores. Magnified 170 times.

Sporangium-wall of one layer, fragile; sporangia saucer-shaped. (10) TRICHAMPHORA.

Fig. 18.

Fig. 18.—*Trichamphora pezizoidea* Jungh.

a. Group of sporangia. Magnified 5½ times.

b. Capillitium with two spores. Magnified 140 times.

D. Lime confined to the stalk and columella, sporangium-wall membranous. (11) DIACHÆA.

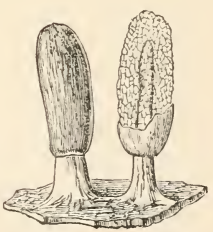

Fig. 19.

Fig. 19.—*Diachæa elegans* Fries.

Two sporangia, the one entire, the other deprived of the spores and showing capillitium and columella. Magnified 22 times.

Genus 2.—**BADHAMIA** Berkeley, in Trans. Linn. Soc., xxi., p. 153 (1852). Sporangia stalked, sessile, or plasmodiocarps; sporangium-wall single, with innate lime-granules sparsely distributed, densely clustered, or forming a thick deposit; columella present or wanting; capillitium consisting of a coarse network charged with granules of lime (in *B. panicea*, *B. decipiens*, and *B. nitens* sometimes constricted here and there into narrow hyaline threads); spores clustered or free, warted, reticulated, or nearly smooth.

KEY TO THE SPECIES OF *BADHAMIA*.

A. Spores clustered:—

a. Spores warted on one side chiefly—

Lime in sporangium and capillitium white. 1. *B. hyalina*

Lime in sporangium and capillitium yellow. 3. *B. nitens*

b. Spores warted equally all over. 2. *B. utricularis*

B. Spores not clustered:—

a. Sporangia yellow or orange. 4. *B. decipiens*

b. Sporangia white or grey—

Sporangia on long membranous stalks, spores nearly smooth, black. 5. *B. magna*

Sporangia sessile or with firm stalks, spores minutely and closely spinulose, dark, purple-brown. 6. *B. macrocarpa*

Sporangia always sessile, spores violet-brown, nearly smooth. 7. *B. panicea*

c. Sporangia flesh-coloured or rufous—

Sporangia sessile, without a true columella. 8. *B. lilacina*

Sporangia stalked; stalk continued into the sporangium as a columella. 9. *B. rubiginosa*

1. **B. hyalina** Berk., in Trans. Linn. Soc., xxi., p. 153 (1852). Plasmodium chrome-yellow. Sporangia globose or pyriform, sessile or stipitate, 0·7 to 1·5 mm. diam., greyish-white, pure white after dispersion of the spores; sporangium-wall hyaline, with lime-granules sparsely distributed. Stalk usually short or wanting, cylindrical or membranous, straw-coloured or dark. Capillitium a network of flat bands with broad, thin expansions at the angles; lime-granules evenly but not densely distributed throughout. Spores dark purple-brown, adhering in clusters of 8 to 20, coarsely warted on the outer third, minutely spinulose on the rest of the surface, 11 to 13 μ diam.—Rost., Mon., p. 139, fig. 113; Cooke, Myx. Brit., p. 25; Blytt, Bidr. K. Norg., Sop. iii., p. 4 (1892). *Physarum hyalinum* Pers., in Römer, N. Mag. Bot., i., p. 88 (1794). *Badhamia capsulifera* Berk., in Trans. Linn. Soc., xxi., p. 153; Rost., Mon., p. 141. *B. varia* Mass., Mon., p. 319 (in part).

α. **genuina**: stalk pale, membranous, or almost wanting; spores in clusters of 10 to 20.

β. **papaveracea**: stalk short, dark; spores in dense clusters of 6 to 10.—*Badhamia papaveracea* Berk. & Rav., in Grev., ii., p. 66; Rost., Mon., App., p. 3; Mass., Mon., p. 323 (in part).

Plate I., B.—*a.* and *b.* var. *genuina* ; sporangia, × 20 (England) ; *c.* capillitium ; *d.* cluster of spores of the same, × 280. *e.* spore, warted on the outer side, × 600 ; *f.* spore almost uniformly spinulose, × 600 ; *g.* var. *papaveracea* ; sporangium, × 20 (New Jersey). *h.* cluster of spores of the same, × 280.

This species forms small plasmodia ; it is subject to much variation in the size of the sporangia and in the character of the stalk and spores. In some gatherings the spores are fuliginous and not so dark as the type, loosely adhering and scarcely rougher on one side, not exceeding 10 to 11 μ diam.; all intermediate forms occur. *B. papaveracea* Berk. & Rav. is an American form differing from the European chiefly in the stalk being usually dark, rigid, even, and filled with refuse matter, and in the spores being in clusters of seldom more than 6 to 10; these characters are not constant, as is shown in specimens B. M. 996, and do not appear to constitute a specific distinction. *B. capsulifera* Berk. is described as having the sporangia somewhat obovate, and the type at Strassburg, referred to in Rostafinski's Monograph, has this form, but the spores are in large clusters, warted on the outer surface, like those of *B. hyalina* ; we not infrequently meet with both globose and pyriform sporangia intermixed ; the shape of the sporangium therefore cannot be accepted as distinctive, and *B. capsulifera* must be included under *B. hyalina*.

Hab. On fir logs, etc., the plasmodium growing in the substance of the logs and spreading between the bark and wood.—*a.* Batheaston, Somerset (B. M. 36) ; Bristol (B. M. 79) ; Leighton, Beds. (L:B.M 2.); Luton, Beds. (L:B.M.2); Lyme Regis, Dorset (L:B.M.2) ; France (Paris Herb.) ; Germany (Strassb. Herb.). *β.* Pennsylvania (B. M. 996B); S. Carolina (B. M. 996A) ; Massachusetts (L:B.M.2).

2. **B. utricularis** Berk., in Trans. Linn. Soc., xxi., p. 153 (1852). Plasmodium chrome-yellow, extensively creeping. Sporangia ovoid subglobose or confluent and lobed, 0·5 to 1 mm. diam., clustered ; cinereous, or iridescent violet, often marked with the white attachments of the capillitium, sessile or on membranous, straw-coloured branching stalks; sporangium-wall hyaline with sparsely distributed minute granules of lime. Capillitium as in *B. hyalina*. Spores bright brown or violet-brown, usually adhering in loose clusters of 7 to 10 ; spinulose 9 to 12 μ diam.—Rost., Mon., p. 142, figs. 110-112 ; Cooke, Myx. Brit., p. 26. *Sphærocarpus utricularis* Bull. Champ., Div. II., p. 128 (1791). *Badhamia varia* Mass., Mon., p. 319 (in part).

Plate II., A.—*a.* cluster of sporangia, × 20 (England) ; *b.* capillitium, × 280 ; *c.* cluster of spores, × 280 ; *d.* spore, × 600.

This species differs from *B. hyalina* in habitat, in having large plasmodia commonly producing some thousands of sporangia, and in the spores being brighter in colour, with coarser and less crowded spines, without the cluster of warts on one side. In cultivations carried on continuously for more than six years, the four varieties described in Rostafinski's Monograph have presented themselves. The capillitium varied both in form and in the amount of lime it contained ; in some the threads were broad with wide expansions at the angles, in others they were narrow and but little widened at the angles ; in some the lime was abundant, in others only a few scattered granules could be found. The agglutination of the spores was seen to vary in different

growths, though all were cultivated from one original gathering of plasmodium, but they were never free as in *B. macrocarpa*. In some specimens in the Strassburg collection the spores show but slight indication of clustering, in others this character is well marked.

Hab. Plasmodium extensively creeping over the bark of fallen trees, logs, etc., feeding on effused fungi, especially *Stereum hirsutum* and *Polyporus versicolor*.—Batheaston, Somerset (B. M. 103); Lyme Regis, Dorset (L:B.M.3); Glamis, Forfarshire (B. M. 149); France (Paris Herb.); Germany (Strassb. Herb.); Italy (K. 165); Massachusetts (L:B.M.3).

3. **B. nitens** Berk., in Trans. Linn. Soc., xxi., p. 153 (1852). Plasmodium yellow. Sporangia sessile, subglobose, gregarious or clustered, or elongated plasmodiocarps about 1 mm. diam.; golden yellow, rugose, or greenish with yellow warts and ridges; sporangium-wall membranous with innate clusters of yellow lime-granules. Columella none. Capillitium yellow or orange, a coarse network of rugged bands, rarely contracted to form short hyaline threads connecting branched lime-knots; deposits of lime usually dense, sometimes sparse. Spores purple-brown, in close clusters of 6 to 10, minutely spinulose, coarsely warted on the outer third, sometimes nearly free and scarcely warted on one side, 10 to 13 μ diam.—Rost., Mon., App., p. 3; Cooke, Myx. Brit., p. 81; Mass., Mon., p. 324. *B. pallida* Berk., in Trans. Linn. Soc., xxi., p. 153. *B. inaurata* Currey, in Trans. Linn. Soc., xxiv., p. 156. *B. papaveracea* Mass., Mon., p. 323 (in part).

Plate III., A.—*a*. group of sporangia, × 20; *b*. capillitium with attachments to the sporangium-wall, × 280; *c*. cluster of spores, × 280; *d*. spore, × 600.

Examination of the type specimens of *B. nitens* and *B. pallida* of Berkeley, from the Rev. C. Badham (Kew 1218, 1235), and of *B. inaurata* Currey (B. M. 151), shows that they are all the same species with yellow sporangium-wall and closely clustered spores coarsely warted on one side.

Hab. In the substance of rotten wood, creeping on moss, etc. Hitherto found only in England.—Lyme Regis, Dorset (L:B.M.4); Luton, Beds. (L:B.M.4); East Bergholt, Essex (K. 1235, 1241); Cray Common, Kent (B. M. 151).

4. **B. decipiens** Berk., in Grev. ii. (1873), p. 66. Plasmodium ? Sporangia branching or vermiform plasmodiocarps, occasionally subglobose, 0·3 to 0·4 mm. diam., sessile, gregarious, rugose or nearly smooth, lemon-yellow or orange; sporangium-wall membranous with innate clusters of yellow lime-granules. Columella none. Capillitium yellow or pale orange, a coarse network densely charged throughout with lime-granules, or formed of large angular and branching lime-knots with few connecting hyaline threads. Spores violet-brown, spinulose, 10 to 13 μ diam.—*Physarum decipiens* Curt., in Am. Journ. Sc., vi. (1848), p. 352. *P. chrysotrichum* Berk. & Curt., in Grev., ii. (1873), p. 66. *Badhamia chrysotricha* Rost., Mon., App., p. 4. *Didymium reticulatum* Berk. & Br., in Herb. Berk. *Lepidoderma*

reticulatum Mass., Mon., p. 252. *Badhamia Alexandrowiczii* Rost., Mon., p. 146; Mass., Mon., p. 324. *Physarum gyrosum* Mass., Mon., p. 307 (in part).

Plate III., B.—*a.* plasmodiocarp, × 20 (New York); *b.* capillitium, × 280; *c.* spore of the same, × 600; *d.* plasmodiocarps, × 20 (S. Carolina: type of Curtis in Strassb. Herb.); *e.* capillitium, × 280; *f.* spores of the same, × 600; *g.* plasmodiocarp, × 20 (Poland: type of *B. Alexandrowiczii* Rost. in Strassb. Herb.); *h.* capillitium, × 280; *i.* spore of the same, × 600.

An authentic specimen from Curtis (B. M. 994) has too little left for identification, yet some spores and a fragment of sporangium which were scraped off were identical with a good typical specimen in Strassb. Herb., sent by Prof. Farlow from Curtis's original gathering.

In the type specimens of both *Badhamia Alexandrowiczii* Rost. and *Didymium reticulatum* Berk. & Br. (B. M. 574), the sporangia are slender, rugose, yellow plasmodiocarps, having Badhamia-like capillitium with few hyaline threads, the spores 10 to 12 μ diam.; they closely resemble the common North American form which appears in the Schweinitzian collection under the name of *Cienkowskia reticulata* Rost. In these American specimens the capillitium has large, branching, pale-yellow lime-knots sparingly connected by hyaline threads. Spores 9 to 11 μ diam. *Badhamia chrysotricha* Rost. differs from the last only in the more completely Badhamia-like capillitium and the rather larger spores, measuring 11 to 13 μ.

Hab. The original specimen was found on the trunk of a living oak. It is found also on dead wood, moss, etc.—Poland (Strassb. Herb. and L:B.M.5 *slide*); Ceylon (B. M. 574); Pennsylvania (L:B.M.5); S. Carolina (B. M. 994).

5. **B. magna** Peck, in Rep. New York Mus., xxxi., p. 57 (1879). Plasmodium? Sporangia globose, 1 mm. diam., violet-grey, the surface wrinkled, iridescent, clustered on long membranous yellowish slender branching stalks, 4 mm. long or more; sporangium-wall with scanty deposits of lime. Columella none. Capillitium as in *B. hyalina* Berk. Spores purplish-black, darker and minutely spinulose on one side, almost smooth, not clustered, 9 to 10 μ diam.—*B. varia* Mass., Mon., p. 319 (in part).

Plate II., B.—*a.* sporangia, × 20 (Vermont: Peck's type); *b.* spores, × 600.

This species has been recorded only from America, and is represented in the collection by a mounting from Peck's type; it is nearly allied to *B. hyalina* Berk.

Hab. On dead wood.—Philadelphia (L:B.M.6).

6. **B. macrocarpa** Rost., Mon., p. 143, figs. 118, 120, 121 (1875). Plasmodium? Sporangia sessile, subglobose, aggregated, or stipitate, gregarious, 0·5 to 1 mm. diam., white, rugose; sporangium-wall membranous, varying in the amount of innate lime-deposits. Stalk when present erect, about 0·7 mm. long, 0·1 mm. diam., thicker above and below, furrowed, yellowish-

brown. Capillitium white, an irregular network formed of broad, branching lime-knots, with narrower connecting strands, charged throughout with granules of lime. Spores dark purple-brown, minutely and closely spinulose all over, not clustered, 11 to 15 μ diam.—Mass., Mon., p. 317. *Physarum macrocarpon* Ces., in Rabenh. Fungi Eur., 1968 (1854); in Flora (1855), p. 271. *Badhamia orbiculata* Rex, in Proc. Acad. Nat. Sci. Phil. 1893, p. 372.

Plate IV., A.—*a*. stalked sporangia, × 20 (Berlin); *b*. sessile sporangia, × 20 (Warsaw: Rostafinski's type); *c*. capillitium and spores of the same, × 280; *d*. spore, × 600; *e*. sporangia, × 20 (England).

The American specimens of this species from Prof. Farlow and Dr. Rex are, as a rule, smaller than the European gatherings, and the stalks, when present, are more slender.

B. orbiculata Rex appears to be a variety differing in the shape of the orbicular or discoidal, depressed sporangia.

Hab. On dead wood.—Luton, Beds. (L:B.M.7); Sutton Coldfield, Stafford (L:B.M.7); Cambridge (L:B.M.7); Holland (Leyd. Herb.); Berlin (B. M. 434); Poland (Strassb. Herb.); Italy (K. 187); Philadelphia (L:B.M.7); Arizona (L:B.M.7).

7. **B. panicea** Rost., in Fuckel Symb. Myc., Nachtr. 2, p. 71 (1873). Plasmodium white. Sporangia sessile, subglobose, 0·4 to 1·2 mm. diam., scattered, or closely aggregated and angled by mutual pressure, white or cinereous; sporangium-wall membranous, with innate deposits of lime-granules in dense clusters forming raised warts or veins. Capillitium white, a profuse network of broad or narrow bands, everywhere charged with granules of lime, often densely confluent at the base, forming an ivory-white columella. Spores violet-brown, very minutely warted, not clustered, 11 μ diam.—Mon., p. 144, figs. 114, 116; Mass., Mon., p. 318. *Physarum paniceum* Fr., Syst. Myc., iii., p. 141 (1829). *Badhamia verna* Rost., Mon., p. 145; Mass., Mon., p. 324.

Plate IV., B.—*a*. sporangia, × 20 (England); *b*. capillitium and spores, × 280; *c*. spore, × 600; *d*. sporangia broken, showing pseudo-columella, × 20; *e*. sporangia of a form without columella and with a closer network of capillitium, × 20.

Badhamia verna Rost. appears to be a form of *B. panicea*; the specimens in Strassb. Herb. differ from the type of the latter species only in the more scanty deposits of lime, and in the narrow bands of the capillitium contracting here and there into hyaline threads. These characters frequently occur in normal British gatherings of *B. panicea*.

Hab. Between the bark and wood of felled elm-trees, etc. Maturing on the outer bark and surrounding herbage.—Batheaston, Somerset (B. M. 77); Lyme Regis, Dorset (L:B.M.8); France (B. M. 425); Germany (B. M. 424).

8. **B. lilacina** Rost., Versuch., p. 10 (1873). Plasmodium bright yellow. Sporangia subglobose, about 0·5 mm. diam., sessile, rarely shortly stalked, gregarious or crowded and angled by mutual pressure, flesh colour or whitish; sporangium-wall opaque from innate deposits of lime. Capillitium flesh coloured or nearly white; a rugged network with large knots of irregular

shape densely charged with lime-granules, often confluent in the centre, forming a pseudo-columella. Spores dark purple-brown, rough or reticulated with prominent and confluent warts, 10 to 15 μ diam.—Rost., Mon., p. 145, figs. 108, 109 (1875); Cooke, Myx. Brit., p. 27. *Physarum lilacinum* Fr., Syst. Myc., iii., p. 141 (1829). *Craterium lilacinum* Mass., Mon., p. 271. *Diderma concinnum* Berk. & Curt., in Grev., ii. (1873), p. 52. *Physarum concinnum* Mass., Mon., p. 308.

Plate V., A.– *a*. sporangia, × 20 (England); *b*. capillitium and spores of the same, × 280; *c*. spore, × 600; *d*. sporangium, showing a pseudo-columella, × 20 (Mecklenburg-Schwerin).

The type of *Diderma concinnum* Berk. & Curt., in the Kew Herb., is a pale whitish form of this species with the characteristic spores and capillitium.

Hab. On *Sphagnum*, twigs, etc., in marshy ground.—Pilmoor, Yorks (L:B.M.9); Scotland (Edin. Herb); Germany (B. M. 488, and Strassb. Herb.); Philadelphia (L:B.M.9).

9. **B. rubiginosa** Rost., Mon., App., p. 5, fig. 115 (1876). Plasmodium ? Sporangia obovoid stalked, 0·5 mm. broad, rufous, or purplish-brown, the upper part usually paler and breaking up in fragments; sporangium-wall purplish, membranous, more or less charged with granules of lime. Stalk cylindrical or widening at the base, usually about the length of the sporangium, smooth, purplish-brown, continued within the sporangium to more than half its height as a columella. Capillitium white or pale rufous, a rugged network usually densely charged with lime-granules, spreading from all parts of the columella to the sporangium-wall. Spores dark purplish-brown, minutely spinulose or verrucose, or reticulated with prominent and confluent warts, 11 to 15 μ diam.—Cooke, Myx. Brit., p. 82; Macbride in Bull. Nat. Hist. Iowa, ii., p. 159. *Physarum rubiginosum* Chev., Fl. Par., p. 338 (1826). *Scyphium rubiginosum* Rost., Mon., p. 148. *Craterium rubiginosum* Mass., Mon., p. 270. *Didymium Curtisii* Berk., in Grev., ii. (1873), p. 65. *Badhamia Curtisii* Rost., Mon., App., p. 5. *Craterium Curtisii* Mass., Mon., p. 272. *Craterium obovatum* Peck, in Rep. New York Mus., xxvi., p. 75.

α. **genuina**: spores minutely spinulose.

β. **dictyospora**: spores strongly warted or reticulated.—*Badhamia dictyospora* Rost., Mon., App., p. 4; Cooke, Myx. Brit., p. 82. *Craterium dictyospermum* Mass., Mon., p. 270.

Plate V., B.—*a*. sporangia, × 20 (England); *b*. broken sporangium from a mounting in glycerine jelly, showing columella surrounded by capillitium, and the mottled sporangium-wall, × 50; *c*. capillitium and spores, × 280; *d*. spore of the same, × 600; *e*. spore, × 600 (Deer Island, St. Lawrence); *f*. spore, × 600 (New Jersey); *g*. spore, × 600 (Appin, Scotland: Rostafinski's type of his *B. dictyospora*).

Didymium Curtisii Berk. differs from the type of *B. rubiginosa* only in being sessile or shortly stalked; in both British and American

gatherings of the latter species, the length of the stalk is subject to great variation. *B. dictyospora* is the name given by Rostafinski to the Appin specimen (K. 193), in which the spores are strongly reticulated. British gatherings have more or less of this character, with prominent warts isolated or confluent; in most American specimens and in that from Chevallier at Paris, which is given by Rostafinski as the type of *B. rubiginosa*, the spores are minutely spinulose. There are intermediate degrees of roughness in American specimens which unite the two forms.

Hab. In woods on fallen brushwood, etc.—*α*. Paris (Strassb. Herb.); Philadelphia (L:B.M.10); Iowa (B. M. 815); S. Carolina (B. M. 406); New York (L.:B.M.10). *β*. Leighton, Beds. (L:B.M.10); Appin, Argyllshire (K. 193).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

10. **B. fasciculata** Rost., Mon., App., p. 2 (1876). Sporangia globose, white, dehiscing irregularly, fugacious above, persistent below; stalks connected in clusters of 3 to 6 or more, erect, tough, dirty yellowish, attenuated upwards, thickened and dark at the base; spores violet, smooth, 11 to 12 μ diam.—*Physarum fasciculatum* Jungh., Fl. Crypt. Jav., p. 11, Pl. II., fig. 8.

Hab. On trunks of *Pandanus*, Java.

11. **B. affinis** Rost., Mon., p. 143 (1873). Sporangia hemispherical, flattened, plano-umbilicate beneath, stipitate, greyish white; sporangium-wall slightly rugose. Spores not clustered, brownish violet, spinulose, 13 to 15 μ.

Hab. On dead leaves and stems. Chili (Bertero).

12. **B. ovispora** Racib., in Rozpr. Mat.-Przyr. Akad. Krak., xii., p. 72, tab. 4, fig. 2 (1884). Sporangia sessile, subglobose, 0·5 to 0·75 mm. broad; sporangium-wall with thick deposits of lime, rough, fragile, the base yellow, the upper part colourless; capillitium with much lime, white, rigid, with large irregular nodes. Columella none. Spores violet, smooth, ellipsoid, 14·5 to 16·5 × 7·5 to 8·3 μ.

Hab. On the branches of *Populus canescens*, DC. Cracow.

13. **B. melanospora** Speg., in Anal. Soc. Cient. Arg., x., p. 150 (1880). Sporangia sessile, densely crowded, globose, smooth, greyish white, white after the dispersal of the spores. Columella none. Capillitium forming a dense network with fusiform thickenings in the middle, and flattened nodes. Spores clustered or free, smooth, black, opaque, angular from mutual pressure, 15 μ diam.

Hab. In decaying trunks of *Cereus Peruvianus* Mill.—Argentina.

14. **B. microcarpa** Schroet., in Cohn, Crypt. Fl. Schlesien, vol. iii., pt. i., p. 131 (1889). Sporangia sessile, about 0·5 mm. broad, occurring in small groups or rows, without a common hypo-

thallus; sporangium-wall thin, bright grey. Capillitium delicate, white, reticulate, with threads of unequal breadth, generally 3 to 4, sometimes as much as 12 μ broad, and thicker at the nodes. Spores single, 7·5 to 9 μ in diameter, violet, smooth.

Hab. On grass and living herbs.—Silesia.

15. **B. irregularis** Cooke & Ellis, in Grev. 1877, p. 89. Sporangia subglobose or confluent, finally blackish-brown, scattered, sessile. Spores rough, globose, blackish, 10 μ in diameter.

Hab. On Jersey pine in a fence.—N. Jersey.

SPECIES EXCLUDED FROM THE GENUS.

B. coadnata Rost. = *Fuligo ellipsospora* Lister.
B. Fuckeliana Rost. = *Trichamphora pezizoidea* Jungh.
B. nodulosa Mass. = *Physarum calidris* Lister.
B. granulifera Mass. See note under *Lepidoderma Carestianum* Rost., p. 106.

Genus 3.—**PHYSARUM** Persoon, in Usteri, Ann. Bot., xv., p. 5 (1795). Sporangia stalked, sessile or plasmodiocarps; sporangium-wall either single or consisting of two more or less separable layers, and containing lime granules distributed in loose or dense clusters or compacted into a crust; the granules always innate and not in superficial crystals. Stalk consisting of a tube with a membranous wall: it may be empty and the wall contracted and wrinkled with longitudinal folds, either translucent or opaque with deposits of lime in the wall substance; or the tube may be filled at the base or throughout with refuse matter discharged from the plasmodium; or the tube may be filled with deposits of lime, giving the stalk a brittle structure with a chalk-like section. Capillitium forming a network of hyaline threads with vesicular expansions containing deposits of lime (=lime-knots).

The genus *Tilmadoche* is described by Rostafinski (Mon., p. 126) as differing from *Physarum* in the capillitium forking repeatedly at a narrow angle, and being provided with few and small lime-knots. These characters are too inconstant to be of value in classification. In *P. leucophæum* Fr., which from its abundance affords ample facility for study, we not unfrequently observe, in a growth sprung from one plasmodium, some sporangia with capillitium characteristic of *Physarum* and others of *Tilmadoche*, completely uniting *P. leucophæum* Fr. with *T. nutans* Rost. *T. gyrocephala* Rost. (syn. *P. polymorphum* Rost.) frequently has capillitium with large lime-knots and broad membranous expansions, and the same may be seen in some gatherings of *P. viride* Pers. (syn. *T. mutabilis* Rost.). The type specimens of *T. oblonga* Rost. and *T. hians* Rost. are the same as *Physarella mirabilis* Peck, which is distinguished from its allies by well-marked characters of shape and capillitium that fully entitle it to the position of a separate genus. For these reasons the genus *Tilmadoche* is not retained.

KEY TO THE SPECIES OF *PHYSARUM*.

A. Sporangia stalked (occasional sessile forms) :—

A. Stalks charged with lime throughout—

a. Capillitium lax—

Stalk white, sporangia grey, lime-knots large, white. 1. *P. leucopus*

Stalk white, sporangia tawny yellow, lime-knots large, white. 8. *P. melleum*

Stalk and sporangium yellow-olive. 7. *P. variabile*

b. Capillitium rigid, persistent—

Stalk white or brownish, sporangium white, lime-knots small, white. 2. *P. globuliferum*

Stalk, sporangium, and lime-knots red. 3. *P. pulchripes*

Stalk, sporangium, and lime-knots mouse-brown. 4. *P. murinum*

Stalk, sporangium, and lime-knots purple. 5. *P. pulcherrimum*

Stalk, sporangium, and lime-knots yellow; robust. 6. *P. citrinum*

Stalk, sporangium, and lime-knots straw-coloured; slender. 9. *P. tenerum*

Stalk and sporangium white, capillitium with a central ball of lime. 10. *P. compactum*

B. Stalks without lime or with deposits in the wall only—

a. Lime-knots purple-red, sporangium rose-red. 11. *P. roseum*

b. Lime-knots and sporangia violet-purple. 12. *P. Newtoni*

c. Lime-knots orange, sporangium mottled, blue and red 13. *P. psittacinum*

d. Lime-knots yellow or orange, sporangium grey or yellow—

Sporangia subglobose, capillitium lax, lime-knots fusiform. 14. *P. viride*

Sporangia undulate, capillitium lax, lime-knots fusiform. 16. *P. polymorphum*

Sporangia subglobose, capillitium subrigid, persistent, lime-knots angular. 15. *P. Berkeleyi*

Stalk penetrating the sporangium to four-fifths its height. 18. *P. penetrale*

e. Lime-knots white, sporangium grey or white—
Stalk straw-coloured, capillitium with a central ball of lime. 17. *P. nucleatum*

Stalk buff, black, or white; sporangium subglobose; spores bright violet-brown. 19. *P. nutans*

Stalk black, buff, or white; sporangium laterally compressed; spores dark purple-brown. 21. *P. compressum*

Stalk red-brown, sporangium globose, white. 20. *P. calidris*

Stalk white, membranous, sporangium ovoid. 22. *P. didermoides*

B. Sporangia sessile (never stalked):—

A. Lime-knots white—

a. Sporangium-wall single, spores pale violet-brown. 23. *P. cinereum*

b. Sporangium-wall double—

α Sporangia scattered—
Sporangia sinuous, muriform, inner wall fragile. 24. *P. bivalve*

Sporangia subglobose, or plasmodiocarps, inner wall persistent. 25. *P. Diderma*

β Sporangia crowded—
Sporangia reniform or subglobose, spores dark, rough, 10 to 14 μ. 26. *P. contextum*

Sporangia angled by mutual pressure, spores pale, nearly smooth, 8 to 10 μ. 27. *P. conglomeratum*

B. Lime-knots red, or yellow—
Lime-knots yellow, small, angular. 28. *P. virescens*

Lime-knots red, large, angular. 30. *P. rubiginosum*

Lime-knots yellow with red centre, rounded. 29. *P. inæquale*

1. **P. leucopus** Link, Diss. I., p. 27 (1809). Plasmodium opaque white. Total height about 1 mm. Sporangia globose, cinereous, or glaucous, 0·5 mm. diam., gregarious, stipitate; sporangium-wall delicately membranous, containing scattered or clustered, white, globular lime-granules. Stalk white, stout, 0·15 to 0·2 mm. thick, with a few shallow longitudinal furrows, erect, rigid, brittle, somewhat narrowing upwards, chalk-white in section to the base, rising from a more or less developed white hypothallus; enclosing no refuse matter. Columella none, or scarcely evident. Capillitium white, consisting of delicate, branching, hyaline threads connecting the large irregular knots,

which are 10 to 50 μ broad and filled with globular lime-granules, 1 to 1·5 μ diam. Spores violet-brown, minutely spinulose, 7 to 10 μ diam.—Rost., Mon., p. 101; Cooke, Myx. Brit., p. 12; Mass., Mon., p. 287 (in part); Macbride, in Bull. Nat. Hist. Iowa, ii., p. 156. *Didymium leucopus* Fr., Syst. Myc., iii., p. 121.

Plate VI., A.—*a*. sporangia, × 20; *b*. capillitium with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (England).

The snow-white nearly smooth stalk, which is chalk-white in section to the base, always distinguishes *P. leucopus* from *P. nutans*. The lax capillitium, with large lime-knots and the large lime-granules in the knots and sporangium-wall, separate it from *P. globuliferum*, which is its nearest ally. The types quoted by Rostafinski from Germany and Russia of this well-marked species are not represented in the Strassburg or British collections; the stations here given are therefore confined to those of the English and American gatherings. It is not common; the only specimen in the Kew collection (K. 518), leg. J. Henderson, is named *Didymium squamulosum*.

Hab. On dead leaves, moss, etc.—Batheaston, Somerset (B.M. 48); Lyme Regis, Dorset (L:B.M.11); Ohio (L:B.M.11); New Granada (Paris Herb.).

2. **P. globuliferum** Pers., Syn., p. 175 (1801). Plasmodium? Total height 1 to 1·5 mm. Sporangia globose, stipitate, erect, white, gregarious, 0·5 mm. diam.; sporangium-wall membranous, with crowded clusters of innate lime-granules. Stalk white or pale buff, sometimes red-brown towards the base, 0·5 to 1 mm. long, ·05 to ·01 mm. thick, nearly smooth, brittle, chalky in section. Columella conical. Capillitium persistent, retaining the form of the sporangium after the dispersion of the spores, forming a close network of obtusely branching hyaline threads with numerous fusiform or rounded, white, or pale ochraceous lime-knots 10 to 20 μ diam.; the lime-knots are not usually developed at the axils of the branches, which are flat and triangular, or if present, usually minute. Spores violet-brown, almost smooth, 6 to 8 μ diam. Rost., Mon., p. 98, fig. 86; Mass., Mon., p. 297. *Sphærocarpus globuliferus* Bull., Champ., p. 134, Pl. 484, fig. 3 (1791). *Physarum Petersii* Berk. & Curt., var. *a. Farlowii* Rost., Mon., App., p. 6. *Physarum albicans* Peck, in Rep. New York Mus., xxx., p. 50; Mass., Mon., p. 312. *Didymium Barteri* Mass., Mon., p. 231. *Physarum columbinum* Macbride, in Bull. Nat. Hist. Iowa, ii., p. 384.

Plate VI., B.—*a*. sporangia, × 20, in two the sporangium-wall has fallen away, leaving the persistent head of capillitium; *b*. stalks showing the columella after the capillitium has broken away, × 20; *c*. capillitium, columella, and spores, × 280; *d*. spore, × 600 (United States).

The types of *P. Petersii* var. *a Farlowii* Rost., and *P. albicans* Peck are the same species as the type of *P. globuliferum* in the Strassburg collection. *P. columbinum* Macbride, from Iowa (B.M. 1012), is also *P. globuliferum*; it has snow-white, occasionally red-brown, stalks, and well-developed conical columellæ. *Didymium Barteri* Mass. (K. 74) appears to have been rightly named by Rostafinski "*P. globuliferum, immaturum*"; the specimen is obscured by mould. In the specimen

from Dr. Rex (L:B.M.12) marked "*P. Petersii* var. *Farlowii*, conglobate form," the sporangia are in clusters of from 6 to 14 together, as in the compound forms of *P. polymorphum*.

Hab. On dead wood.—Poland (Strassb. Herb); Africa (K. 74); Bonin Island (K. 333); Borneo (L:B.M.12); Ohio (L:B.M.12); Iowa (B.M. 1012, 1015); Georgia (B.M. 853B); conglobate form, Philadelphia (L:B.M.12).

3. **P. pulchripes** Peck, in Bull. Buff. Soc. N. Hist., i., p. 64 (1873). Plasmodium ? Total height 1 to 2 mm. Sporangia globose, stipitate, yellow-orange, orange-red to dark brown, sometimes grey from the absence of lime, about 0·5 mm. diam.; sporangium-wall membranous, with deposits of lime usually abundant, sometimes scanty. Stalk vermilion-red or red-brown, 0·5 to 1·5 mm. long, 0·1 mm. thick, somewhat narrowed upwards, densely charged with red or brown lime-granules, brittle. Columella conical. Capillitium with red or brown lime-knots, in other respects as in *P. globuliferum*. Spores violet-brown, almost smooth, 6 to 8 μ diam.—Mass., Mon., p. 315. *Didymium erythrinum* Berk., in Grev., ii. (1873), p. 52; Mass., Mon., p. 249. *Didymium Ravenelii* Berk. & Curt., in Grev., ii. (1873), p. 53; *Physarum Ravenelii* Mass., Mon., p. 281.

Plate VII., A.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (United States).

A frequent species in the United States, differing from *P. globuliferum* chiefly in the colour of the lime; and this character appears to be constant. Under *P. pulchripes* are included *Didymium erythrinum* Berk. and *D. Ravenelii* Berk. & Curt., which Rostafinski in the Appendix to his Mon., p. 8, has placed under *Physarum psittacinum*, a species without columella and without lime-granules in the stalk. Examination of the types in the Kew collection shows that the sporangia of *D. erythrinum* (K. 1265) are immature, but those of *D. Ravenelii* (K. 1513 and B.M. 569) possess a well-developed columella, and the stalks in both types are densely charged with lime-granules.

The type of *P. Petersii* Berk. & Curt. in Grev., ii., p. 66 (1873); Rost., Mon., App., p. 6 (K. 1254), belongs also to *P. pulchripes*. So much confusion has been caused by Berkeley and Curtis in giving different names to different gatherings of this species, and by Rostafinski in placing *P. globuliferum* as a variety of *P. Petersii*, that Peck's name is adopted as being free from ambiguity.

Hab. On dead wood.—Massachusetts (L:B.M.13); Ohio (L:B.M.13); N. Carolina (B. M. 569, 852A).

4. **P. murinum** Lister sp. nov. Plasmodium ? Sporangia globose, about 0·5 mm. diam., stalked or sessile and forming plasmodiocarps, pinkish or yellowish brown, rugose; sporangium-wall membranous, with innate clusters of brown lime-granules. Stalk erect, 0·5 mm. long or shorter, 0·1 mm. thick, of equal breadth throughout; pale brown, furrowed, containing dense deposits of white lime-granules. Columella present in the stalked forms, conical. Capillitium forming either a dense network of obtusely branching hyaline threads, persistent after the dispersal of the

spores, with rather few ovoid brown lime-knots, or a looser network of hyaline threads, with numerous elongated irregularly branching lime-knots. Spores pale brownish-violet, nearly smooth, 8 to 10 μ diam.—*P. Braunianum* List. in Journ. Bot. 1891, p. 259 (non de Bary).

Plate VII., B.—*a.* sporangia, × 20; *b.* plasmodiocarp, × 20; *c.* capillitium and spores, × 280; *d.* spore, × 600 (United States).

This species is closely allied to *P. globuliferum*, from which the stalked form scarcely differs except in the brown colour of the lime in the capillitium and sporangium-wall. The specimen from Moffat, described in Journ. Bot., 1891, under the name *P. Braunianum* de Bary, agrees with de Bary's description of that species in the usually sessile form and brown lime-knots of the capillitium, but as the type consists of only a single gathering by A. Braun near Berlin, and is not represented in the Strassburg or British collections, no proof of identity has been obtained; the Moffat specimen is therefore placed under *P. murinum*, the sessile American forms of which it closely resembles.

Hab. On dead leaves, wood, etc.—Moffat (L:B.M.14); Philadelphia; (L:B.M.14); Ohio (L:B.M.14).

5. **P. pulcherrimum** Berk. & Rav., in Grev., ii., p. 65 (1873). Total height 1 mm. Sporangia globose, flattened beneath, stipitate, erect or inclined, purple, 0·4 to 0·5 mm. diam., gregarious. Sporangium-wall membranous, pale purple, with scattered clusters of large purple globular lime granules (1 μ diam.) Stalk purple, subulate, brittle, containing lime. Columella small, convex, or none. Capillitium a close network of delicate purplish threads, broader and more expanded at the axils below; lime-knots numerous, small, roundish, filled with purple globular lime-granules. Spores pale dull red, almost smooth, 7 to 8 μ diam. —Rost. Mon., p. 105, fig. 84; Mass., Mon., p. 293. *Physarum atrorubrum* Peck, in Rep. New York Mus., xxxi., p. 40; Mass., Mon., p. 294.

Plate VIII., A.—*a.* sporangia, × 20; *b.* capillitium with fragment of sporangium-wall and spores, × 280; *c.* spore, × 600 (United States).

P. atrorubrum Peck is the same species (teste Dr. G. A. Rex).

Hab. On dead wood.—Ohio (L:B.M.15); Philadelphia (L:B.M.15); Iowa (B.M. 1013); S. Carolina (B. M. 412, 869).

6. **P. citrinum** Schumacher, Enum. Pl. Saell., ii., p. 201 (1803). Plasmodium ? Total height 0·8 to 2 mm. Sporangia globose, rugose, stipitate, rarely nearly sessile, erect, yellow to yellowish grey, 0·4 to 0·7 mm. diam.; sporangium-wall membranous with innate clusters of yellow lime granules. Stalk golden yellow, opaque with dense deposits of lime, stout, somewhat furrowed, varying in length, chalky in section, often rising from a vein-like hypothallus. Columella short, conical, or obtuse. Capillitium a somewhat close network of hyaline rigid threads with flat expansions at the axils, persistent after the dispersion of the spores; lime-knots yellow, numerous, varying in shape and size, usually rounded, seldom developed at the axils of the branches.

Spores violet-brown, almost smooth, 7 to 8 μ diam.—Rost. in Fuckel Symb. Myc., Nachtr., 2, p. 71. *P. Schumacheri*, Spreng. Sys. Veg., iv., p. 528; Rost., Mon., p. 98, App., p. 6; Cooke, Myx. Brit., p. 11; Mass., Mon., p. 275. *P. Leveillei* Rost., Mon., App., p. 7; Mass, Mon., p. 296.

Plate VIII., B.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (England); *d*. sporangium showing columella, × 20 (Germany, Strassburg Herb.).

P. Kalchbrenneri Mass., from the Cape (K. 347), is allied to *P. citrinum*, differing chiefly in the capillitium, which approaches that of *Badhamia*; the nodes are irregularly expanded, bright yellow, and connected by more or less hyaline strands, 2 to 5 μ broad; columella none, spores 8 to 10 μ. Rostafinski separates *P. Schumacheri*, vars. β and γ, Mon., p. 99, and places them in his Appendix under the name of *P. Leveillei*; the type specimen of var. β from Freiburg in the Strassburg collection is a large form of *P. citrinum*, but is fully equalled by the English gathering figured; the spores measure 8 to 9 μ; the type of var. γ from Munster is a very different form, and appears to be more nearly allied to *P. rubiginosum*. The specimen from Venezuela in the Kew collection, marked by Rostafinski *P. Leveillei* var. β, has a longer stalk than the typical *P. citrinum*, a more lax capillitium, and the spores measure 10 μ, but it can scarcely be viewed as a distinct species.

Hab. On dead wood, moss, etc.—Bedfordshire (L:B.M.16); Germany (Strassb. Herb); Freiburg (L:B.M.16; Venezuela (K. 1261).

7. **P. variabile** Rex, in Proc. Acad. Nat. Sc. Phil., 1893, p. 371. Plasmodium? Total height about 1 mm. Sporangia piriform, ovoid, or subglobose, 0·4 to 0·5 mm. broad, stalked or sessile, rugose, somewhat glossy, yellowish olive; sporangium-wall membranous, with dense innate deposits of yellowish lime-granules. Stalk stout, conical, furrowed, 0·4 mm. high or less, yellowish-brown, densely charged with white lime-granules. Columella none. Capillitium a close network of delicate hyaline threads with membranous expansions at the axils of the branches; lime-knots numerous, irregularly branching, many large and confluent, white or pale yellow. Spores brownish-violet, spinulose, 9 to 12 μ diam.

Plate IX., A.—*a*. sporangia, × 20; *b*. broken stalk showing lime; *c*. capillitium, with fragment of sporangium-wall and spores, × 280; *d*. spore, × 600 (United States).

Hab. On dead wood.—Iowa (B.M. 812); New York (L:B.M.17); Venezuela (L:B.M.17).

8. **P. melleum** Mass., Mon., p. 278 (1892). Plasmodium? Total height 0·8 mm. Sporangia globose, stipitate, erect, brownish-yellow, 0·5 μ diam.; sporangium-wall membranous, often wrinkled, persistent at the base, yellowish, with minute coloured lime granules sparsely distributed. Stalk white or faintly buff coloured, stout, opaque, with few shallow furrows, chalky in section. Columella short, conical. Capillitium of irregularly-branching delicate hyaline threads, sometimes expanded at the

axils, lime-knots usually numerous, white, various in shape and size, mostly large and angled. Spores violet-brown, almost smooth, 7 to 10 μ diam.—*Didymium melleum* Berk. & Br., in Linn. Jour., xiv., p. 83 (1873). *Physarum Schumacheri*, var. β *melleum* Rost., Mon., App., p. 7. *Didymium chrysopeplum* Berk. & Curt. in Grev., ii. (1873), p. 53.

Plate IX., B.—*a.* sporangia, and one stalk showing a small columella, × 20; *b.* broken sporangia showing white capillitium, × 20; *c.* capillitium and fragment of sporangium-wall, × 280; *d.* spore, × 600 (United States).

Allied to *P. citrinum*, but constant in its characters; of frequent occurrence in the United States.

Hab. On dead wood, leaves, etc.—Cape (K. 57); Ceylon (B.M.411); Borneo (K. 1257); Philadelphia (L:B.M.18); Ohio (L:B.M.18); Iowa (B.M. 1018); S. Carolina (B. M. 409, 853A).

9. **P. tenerum** Rex, in Proc. Acad. Nat. Sc. Phil. 1890, p. 192. Plasmodium? Total height, 1 to 2 mm. Sporangia globose, stipitate, somewhat nodding, gregarious, yellow, 0·4 mm. diam.; sporangium-wall membranous with closely-set rounded thin clusters of innate yellow granules. Stalk subulate, slender, opaque, 0·5 to 1·7 mm. long, pale yellow and filled with lime above, darker below from the presence of refuse matter. Columella none. Capillitium of very delicate hyaline threads forming a regularly meshed network, often persistent after the dispersion of the spores, with numerous round or rounded yellow lime-knots, the branches slender at the axils and mostly free from lime. Spores violet-brown, nearly smooth, 7 to 8 μ diam.

Plate X., A.—*a.* sporangia, × 20; *b.* stalk and capillitium, × 170; *c.* capillitium and spores, × 280; *d.* spore, × 600 (United States).

This species is closely allied to *P. citrinum*, differing in the more slender form, in the delicate flexuose capillitium threads connecting the lime-knots, and in the absence of a columella. Specimens sent by Dr. Haviland from Borneo are similar to the type of Dr. Rex. A gathering from Mr. Morgan, Ohio, has small grey sporangia, 0·25 mm. diam., rugose, with deposits of white lime-granules in the sporangium-wall; in other respects it is typical.

Hab. On dead wood.—Borneo (L:B.M.19); New York (L:B.M.19); Ohio (L:B.M.19).

10. **P. compactum** Lister. Plasmodium? Total height 1 to 2 mm. Sporangia globose or somewhat flattened below, 0·5 mm. diam., stipitate, erect or nodding, spotted with pure white; grey or bronze colour and iridescent between the rounded spots; sporangium-wall membranous, with numerous well defined rounded clusters of closely compacted lime granules. Stalk erect or flexuose, subulate, furrowed, 0·5 to 1·5 mm. long., 0·05 to 0·13 thick at the base; white and densely charged with lime above, brown or black below from the presence of refuse matter; or white with chalky section to the base. Columella none, or represented by closely compacted lime-knots forming a globular cluster 0·1 mm. diam. at the apex of the stalk, but lying free in the

capillitium. Capillitium abundant, of extremely delicate branching and anastomosing threads without expansions at the axils, somewhat persistent, and of a pale bluish colour after the dispersion of the spores; lime-knots white, few, small, fusiform except in the central globular cluster. Spores violet-brown, almost smooth, 7 to 9 μ diam.—*Tilmadoche compacta* Wing., in Proc. Acad. Nat. Sc. Phil. 1889, p. 48; Mass., Mon., p. 332. *Lepidoderma stellatum* Mass., Mon., p. 252.

Plate X., B.—*a*. sporangia, × 20; *b*. stalk and capillitium with pseudocolumella and fragment of sporangium-wall, showing compacted and sharply-defined clusters of lime-granules, × 80; *c*. capillitium and spores, × 280; *d*. spore, × 600 (Dominica).

An excellent account of this species is given by Mr. Wingate (l.c., p. 48). He describes the sporangium-wall as splitting on maturity in a floriform manner, which is a marked character in the specimens at hand; his description of the stalk as "yellowish-white with a brown or blackish base" appears to be correct for the American gatherings. In a fine specimen of *P. compactum* in the Kew collection from Dominica (Ramage), K. 567, marked *Lepidoderma stellatum* Mass., the stalks are pure white with a chalky section to the base. The specimen from French Guiana in the Paris Museum under the name *Physarum leucophæum* is precisely similar to that from Dominica in the large opaque white lime-spots on the sporangium-wall and in the pure white stalks. The type of *Didymium columbinum* Berk. & Curt. (*Tilmadoche columbina* Rost., Mon., App, p. 13), Venezuela (K. 1428), appears to be this species, but nothing now remains of the specimen but a few stalks and a little of the extremely delicate capillitium.

Hab. On dead wood.—Borneo (L:B.M.20); Dominica (K. 567); Philadelphia (B. M. 875, L:B.M.20); Ohio (L:B.M.20); French Guiana (Paris Herb.).

11. **P. roseum** Berk. & Br., in Journ. Linn., xiv., p. 84 (1873). Plasmodium? Total height 1 mm. Sporangia globose, 0·4 mm. diam., stalked, gregarious, nearly smooth, bright rose-coloured; sporangium-wall membranous, with innate clusters of purple-red lime-granules. Stalk erect, slender, subulate, reddish-brown, translucent, longitudinally rugose. Columella none. Capillitium a loose network of delicate pale lilac hyaline threads, with rather few large, irregularly branching, purple-red lime-knots. Spores reddish-lilac or reddish-brown, minutely spinulose, 7 to 10 μ diam. Rost., Mon., App., p. 10; Mass., Mon., p. 294.

Plate XI., A.—*a*. sporangia, × 20; *b*. capillitium with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (Borneo).

This species differs from *P. pulcherrimum* in the large lime-knots and the translucent stalk.

Hab. On dead wood.—Ceylon (K. 1758); Borneo (L:B.M.21).

12. **P. Newtoni** Macbride, in Bull. Nat. Hist. Iowa, vol. ii., 4, p. 390 (1893). Plasmodium? Sporangia shortly stalked or sessile, globose, about 0·5 mm. diam., or flattened and umbilicate above, violet-purple, smooth, opaque; sporangium-wall membranous above, with innate deposits of purple lime-granules, rugose and thickened towards the base, where it is deep purple

and densely charged with calcareous deposits. Stalk coarsely wrinkled, purple-brown. Columella none. Capillitium of delicate, branching, violet threads, with numerous large, angular, purple lime-knots. Spores dark purple-brown, rough with irregularly scattered warts 8-10 μ diam.

Plate XVII., B.—*a.* stalked and sessile sporangia, × 20 ; *b.* capillitium and spores, × 280 ; *c.* spore, × 600 (Colorado).

The shape of the sporangia and the dark rough spores appear to be the only points which distinguish this species from *Craterium rubescens* Rex, with which it agrees in colour, in the character of the capillitium, and in the structure of the sporangium-wall.

Hab. On sticks, on mountain, Colorado (B. M. 1014).

13. **P. psittacinum** Ditm., in Sturm, Deutsch. Fl., Pilze, p. 125, t. 62 (1817). Plasmodium orange, in the substance of rotten wood. Total height 1 mm. Sporangia globose or somewhat depressed, stipitate, gregarious, 0·5 to 0·8 mm. diam., purplish-blue mottled with red, iridescent; sporangium-wall hyaline, delicately membranous, sprinkled with orange spots of thicker, more or less granular substance. Stalk equal, erect or curved, furrowed and rugose, vermilion or orange-red, intense clear orange in mountings in glycerine, without deposits of lime, rising from a well-developed hypothallus of the same colour, 0·5 to 0·7 mm. long, 0·1 mm. thick. Columella none. Capillitium a close network of flat, arching, colourless or yellowish threads, broad at the axils; lime-knots numerous, varying in size, sharply angular, often branching, or confluent in the centre of the sporangium, bright orange, obscurely granular or translucent. Spores fuliginous-violet, smooth or nearly so, 7 to 8 μ diam.—Rost., Mon., p. 104, figs. 75, 76; Lister in Journ. Bot. 1891, p. 257, Pl. 308, fig. 1; Mass., Mon., p. 274. *P. Carlylei* Mass., Mon., p. 293.

Plate XI., B.—*a.* sporangia, × 20; *b.* capillitium with fragment of sporangium-wall showing crystalline discs, × 280; *c.* spore, × 600 (England).

The specimens in the Kew collection named *Didymium erythrinum* Berk. and *D. Ravenelii* Berk. & Curt., given by Rostafinski as synonyms of *P. psittacinum*, must be referred to *P. pulchripes*. The type specimens of *P. psittacinum* in the Strassburg collection are of the form described above. The type specimen of *P. Carlylei* Mass. (K. 68) is normal *P. psittacinum*. In glycerine mountings, flattened disc-shaped crystalline bodies with radiating structure are usually seen imbedded in the sporangium-wall, as in *P. virescens* var. *genuina*.

Hab. On dead wood.—Germany (B. M. 1109); Poland (Strassb. Herb.); New York (K. 1266); Carlisle (K. 68); Lyme Regis, Dorset (L:B.M.22).

14. **P. viride** Pers., in Usteri, Ann. Bot., xv., p. 6 (1795). Plasmodium yellow, in rotten wood. Total height 1 mm. Sporangia globose, lenticular, stipitate, nodding, 0·3 to 0·5 mm. diam., yellow, greenish, or orange; sporangium-wall membranous with innate clusters of yellow or orange lime-granules more or less closely disposed. Stalk subulate, slender, striate, grey or straw-coloured, often darker below from enclosed refuse matter, without deposits

of lime. Columella none. Capillitium a loose irregular network of delicate hyaline threads, not expanded at the axils, with fusiform or angled orange lime-knots. Spores violet-brown, almost smooth, 7 to 10 μ diam.—*Stemonites viridis* Gmelin, Syst. Nat., ii., p. 1469 (1791). *Physarum aureum* Pers., in Römer, N. Mag. Bot., p. 88. *P. nutans, β viride, γ aureum, δ coccineum*, Fr., Syst. Myc., iii., p. 129. *Tilmadoche mutabilis* Rost., Mon., p. 129, figs. 123-27, 132; Cooke, Myx. Brit., p. 22; Mass., Mon., p. 329. *Tilmadoche viridis* Sacc., Syll., vii., No. 1247; Macbride, in Bull. Nat. Hist. Iowa, ii. (1892), p. 152.

α. **luteum**: sporangia yellow.—*Sphærocarpus luteus* Bull., Champ., Pl. ccccvii., fig. 2.

β. **aurantium**: sporangia orange.—*Sphærocarpus aurantius* Bull., Champ., Pl. ccccIxxxiv., fig. 2.

γ. **incanum**: sporangia grey.

Plate XII., A.—*a.* sporangia, × 20; *b.* capillitium, with fragment of sporangium-wall and spores, × 280; *c.* spore, × 600 (England).

In this variable species, as in *P. nutans*, the sporangium-wall is somewhat persistent when the lime is abundant; when this is more scanty the wall soon breaks up in small fragments, remaining attached to the capillitium. The colour of the sporangia found on the same stump may differ from one year to another. The lime-knots are very variable both in size and colour; pale yellow sporangia have often red-brown knots, and dark sporangia have light orange knots; occasionally the sporangia are grey and the lime-knots pale yellow, approaching *P. nutans*. The stalks vary in tint in all forms. The specimens from Chili (Gay) in the Paris Museum, given by Rostafinski (Mon., App., p. 7) as a type of *Physarum Lereillei*, is the orange form of *P. viride*; the stalks are free from lime deposit, the capillitium consists of slender threads and fusiform orange lime-knots.

Hab. On dead wood.—*α.* and *β.* Leytonstone, Essex (L:B.M.23); France (Paris Herb.); Germany (B .M. 506); Borneo (L:B.M.23); New Jersey (L:B.M.23). *β.* Poland (Strassb. Herb.); Ceylon (K. 1420); Bonin Islands (K. 335); Chili (Paris Herb.). *γ.* Bohemia (B. M. 503); Iowa (B. M. 805).

15. **P. Berkeleyi** Rost., Mon., p. 105, fig. 88 (1875). Plasmodium yellowish-green (teste Ravenel). Total height 1·75 mm. Sporangia subglobose, or flattened beneath, stipitate, nodding, 0·4 to 0·5 mm. diam., grey and yellow at the base, yellow or iridescent from the absence of lime; sporangium-wall membranous, colourless above, thicker and yellowish below. Stalk slender, subulate, striate, without deposits of lime, red or copper coloured. Columella none. Capillitium a close network of delicate hyaline threads with numerous yellow flat expansions at the axils; often persistent and retaining the form of the sporangium after dispersion of the spores; lime-knots usually small, angular, yellow. Spores pale violet-brown, almost smooth, 7 to 9 μ diam.—*Physarum flavicomum* Berk., in Hook. Journ. Bot., iv., 1845, p. 66. *Physarum cupripes* Berk. & Rav., in Grev., ii., p. 65, 1873; Mass., Mon., p. 284. *Didymium flavicomum* Mass., Mon., p. 242.

P. galbeum Wing., Ell. & Everh., N. Am. Fung., 2491. *P. Petersii* Mass., Mon., p. 295 (in part).

Plate XII., B.—*a.* sporangia, × 20; *b.* capillitium and spores, × 280; *c.* spore, × 600 (United States).

The red-brown stalks and the larger expansions of the capillitium at the axils of the branches distinguish this species from *P. viride*. *P. galbeum* Wing. (L:B.M.24) has globose orange-yellow sporangia, and orange-brown stalks entirely free from lime; the capillitium is a close network of threads expanded and flattened at the axils, with few or no deposits of lime. Similar forms have been found near Lyme Regis. They are here included under *P. Berkeleyi*, but other gatherings from Lyme Regis connect these forms with *P. viride*, making it doubtful whether *P. Berkeleyi* is not merely a marked variety of that species. The specimen from Iowa (B. M. 1017) resembles the type of *P. galbeum*, except that the capillitium consists of a close network of large branching knots, densely charged with yellow lime-granules, connected by few branching hyaline threads; the spores measure 8 μ. This form is nearly related to a specimen from Mossman's Bay, Sydney, Australia (K. 346), marked *Tilmadoche mutabilis*, with capillitium of a Badhamia-like character, the threads being charged throughout with yellow lime-granules; the spores are spinulose and measure 10 to 13 μ. This is connected with *P. viride* by a series of intermediate specimens from Ceylon (also in Kew Herb.) with unusually extended lime-knots and large spores, but the rigid persistent capillitium brings it under the definition of *P. Berkeleyi*.

Hab. On dead wood.—Swan River, Australia (K. 1328); Iowa (B. M. 1017); So. Carolina (B. M. 439, 870, 993); Massachusetts (L:B.M.24).

16. **P. polymorphum** Rost., Mon., p. 107 (1875). Plasmodium occurring in masses of decaying leaves or in rotten logs, at first colourless, as it emerges for fructification white, then yellow, spreading far over all adjacent objects (Macbride). Total height 1·5 to 2 mm. Sporangia much compressed, lenticular, and umbilicate, undulate, or lobed convolute and often confluent, stipitate, solitary or in clusters of 5 to 10 together, grey or yellow; sporangium-wall membranous, with scattered thin innate clusters of white or yellow lime-granules. Stalks subulate, slender, inclined, often fasciculate, 5 to 10 combined, yellow or tawny, translucent, without deposits of lime. Columella none. Capillitium a loose network of delicate threads with many flat expansions at the axils; lime-knots yellow, very variable in shape, size, and abundance. Spores violet-brown, minutely spinulose, 8 to 10 μ diam.—Mass., Mon., p. 283. *Didymium polymorphum* Mont., in Ann. Sci. Nat., Ser. 2, viii., p. 361 (1837). *Didymium luteo-griseum* Berk. & Curt., in Grev., ii. (1873), p. 65. *Didymium obrusseum* Berk. & Curt., in Journ. Linn. Soc., x., p. 348 (1869). *Physarum obrusseum* Rost., Mon., App., p. 11. *Didymium tenerrimum* Berk & Curt., *l.c.*; Mass., Mon., p. 247. *D. gyrocephalum* Mont., in Ann. Sci. Nat., Ser. 2, viii., p. 362. *Tilmadoche gyrocephala* Rost., Mon., 131; Mass., Mon., p. 335; Macbride, in Bull. Nat. Hist. Iowa, 1892, p. 152.

α. **obrusseum**: sporangia simple.

β. **gyrocephalum**: sporangia clustered.

Plate XIII., A.—*a*. sporangia closely combined, × 20 ; *b*. sporangia more or less simple, × 20; *c*. capillitium and spores, × 280 ; *d*. spore, × 600 (United States).

Under *P. polymorphum* is included *Didymium obrusseum* Berk. & Curt. and *Tilmadoche gyrocephala* Rost. I have not seen Rostafinski's types of the latter. The specimens issued by Ellis and Everhart, 2699 N. A. F., and those received from Dr. Rex of Philadelphia and Prof. Macbride of Iowa, under the name *T. gyrocephala*, agree with the description given by Rostafinski. The colour of the sporangia varies from grey to yellow in the same gatherings. Examination of the capillitium and spores of these specimens and of the types of *P. obrusseum* and *P. polymorphum* shows that they are essentially alike ; of the characters given above the clustering of the sporangia cannot be held as of specific importance (cf. *P. globuliferum*). In the type of *Didymium obrusseum* Berk. & Curt., No. 532 F. Cub. (B. M. 440), the sporangia are much compressed and undulated, and are similar to the simple sporangia frequently met with in *P. polymorphum*.

Hab. On dead wood, etc.—*a*. and *β*. So. Carolina (B. M. 856, 862). *a*. Cuba (B. M. 440). *β*. Pennsylvania (B. M. 860) ; Iowa (L:B.M.25); Ohio (L:B.M.25) ; Long Island, N.Y. (B. M. 1054).

17. **P. nucleatum** Rex, in Proc. Ac. Nat. Sc. Phil. 1891, p. 389. Plasmodium ? Total height 1 to 2 mm. Sporangia globose, stipitate, erect or inclined, 0·5 mm. diam., white ; sporangium-wall membranous, with scattered innate clusters of white lime-granules. Stalk subulate or nearly equal, 0·7 to 1·5 mm. long, longitudinally rugose, pale buff, translucent above, without deposits of lime, enclosing refuse matter below. Columella none. Capillitium a very close network of delicate colourless threads, equal or with triangular expansions at the axils, with scattered minute rounded white lime-knots ; persistent after the dispersion of the spores. In the centre of the capillitium is suspended a calcareous shining white ball, 0·1 to 0·15 mm. diam., sometimes replaced by a compacted mass of irregular lime-knots. Spores violet-brown, minutely spinulose, 6 to 7 μ diam.

Plate XIII., B.—*a*. sporangia with the spores dispersed and only the basal part of the sporangium-wall remaining, × 20 ; *b*. stalk and capillitium showing the central ball of lime, × 80 ; *c*. capillitium and spores, × 280 ; *d*. spore, × 600 (United States).

The type specimen of *P. simile* Rost., from Curtis, South Carolina (K. 1255), has buff stalks without lime deposits, and delicate persistent capillitium with a central mass of lime ; it is a poor development and in imperfect preservation, but there can be little doubt that it is the same species as *P. nucleatum*, although Rostafinski's description of *P. simile* with the stalk continued into the sporangium as a cylindrical columella would apply better to *P. globuliferum* (Rost., Mon., App., p. 6).

Hab. On dead wood.—Pennsylvania (L:B.M.26); Iowa (B. M. 1019).

18. **P. penetrale** Rex, in Proc. Ac. Nat. Sc. Phil. (1891), p. 389 Plasmodium ? Sporangia erect, ellipsoid, rarely globose, 0·3 × 0·5 mm. by 0·5 × 0·7 mm., stipitate, grey or pale greenish-yellow ; sporangium-wall membranous, rather firm, semi-trans-

parent, with innate scattered clusters of pale yellow or yellowish-grey lime-granules; rupturing when mature into from two to four segments. Stalk erect or curved, 0·5 to 2 mm. high, slender, subulate, translucent, dull red or golden red. Columella formed by a continuation of the stalk, penetrating the sporangium to about four-fifths its height, slender, scarcely tapering to the wedge-shaped end, reddish-yellow. Capillitium a close network of hyaline threads with triangular expansions at the axils of the branches, arising from the whole length of the columella, persistent after the dispersion of the spores; lime-knots scattered, small, rounded, yellow. Spores pale brownish-violet, delicately spinulose, 5 to 6·5 μ diam.

Plate XIV., A.—*a.* sporangia, ellipsoid form, × 20; *b.* sporangia, globose form, × 20; *c.* apex of stalk bearing the columella and capillitium, × 100; *d.* capillitium and spores, × 280; *e.* spore, × 600 (United States).

An immature specimen of this species occurs in the Strassburg collection named by Rostafinski "*Craterium leucocephalum unreif.*" It agrees in all respects with the American type of *P. penetrale*, and is interesting as being apparently the only European gathering.

Hab. On dead wood and moss.—Germany (Strassb. Herb.); Philadelphia (L:B.M.27)

19. **P. nutans** Pers., in Usteri, Ann. Bot., xv., p. 6 (1795). Plasmodium watery white or yellowish-grey from the presence of foreign matter. Total height 1 to 1·5 mm. Sporangia subglobose, more or less flattened or concave beneath, 0·4 to 1 mm. broad; white, greyish-white, or violet-grey; gregarious, stipitate, sessile, or plasmodiocarps; sporangium-wall membranous, with innate minute white granules in more or less dense clusters. Stalk subulate, longitudinally wrinkled, cernuous or erect, yellowish, olivaceous or dark, translucent above, sometimes opaque and white from deposits of lime in the wall, the tube of the stalk containing refuse matter but not lime (never with chalk-white fracture at the base as in *P. leucopus*). Columella none. Capillitium of colourless threads, either slender, forked and anastomosing with few flat expansions at the axils and few small white lime-knots, or with broad, often perforated expansions and large lime-knots. Spores clear violet-brown, nearly smooth or minutely spinulose, 8 to 11 μ diam.—Pers., Syn., p. 171; Fr., Syst. Myc., iii., p. 128. *Tilmadoche nutans* Rost., Mon., p. 127; Cooke, Myx. Brit., p. 21; Mass., Mon., p. 327. *Physarum leucophœum*, Fr., Sym. Gast., p. 24 (1818); Rost., Mon., p. 113, figs. 77, 78, 89; Cooke, Myx. Brit., p. 15; Mass., Mon., p. 288. *Physarum gracilentum* Fr., Syst. Myc., iii., p. 133 (1829). *Tilmadoche gracilenta* Rost., Mon., p. 129; Mass., Mon., p. 330. *Physarum granulatum* Balf., in Grev., vol. x. (1882), p. 115; Mass., Mon., p. 289. *Physarum Readeri* Mass., Mon., p. 282.

An extremely variable species; the stalked and plasmodiocarp forms may develop from the same growth of plasmodium. Sporangia may be found with delicate capillitium and few minute lime-knots, associated with others from the same plasmodium with wide expansions at the

angles of the threads and with large lime-knots ; some may have erect stalks enclosing much refuse, standing with others more weakly formed, containing little refuse matter and cernuous from the weight of the sporangium. As in all the *Calcarineæ* the amount of lime in the sporangium-wall is liable to great variation ; where the supply is abundant it gives firmness and persistence to the membrane ; where it is scanty the wall is fragile or evanescent, as in the form named *Tilmadoche nutans*. In contrast with the latter, a robust form occurs, having a short stout stalk, often projecting within the sporangium in a conical point, with lime-knots of large size, either distributed among the capillitium or confluent in the centre ; between these extreme forms all shades of difference may be found, making it difficult to define even distinct varieties. Examination of a large series leads to the conclusion that *P. leucophæum* is not a distinct species, but must be included under *P. nutans*. The name *P. leucophæum* has been so long established as applied to a well-recognised form, that it would have been desirable in some respects to retain it as representing the type of this species ; but as the name *P. nutans* was given by Persoon twenty-three years earlier than that by Fries, the rules of precedence necessitate its adoption.

The diverging forms may be approximately described as follows, being arranged according to the amount of lime in the sporangium-wall and capillitium.

α. **violascens** Rost., Mon., p. 114 ; sporangium-wall iridescent, fragile, free from lime ; capillitium without lime-knots, stalk cernuous. Spores nearly smooth, 8 to 9 μ diam.

β. **genuinum** : sporangium-wall with thin, innate clusters of lime-granules, fragile ; capillitium slender with few flat expansions at the angles and few small lime-knots ; stalk cernuous. Spores nearly smooth, 8 to 9 μ diam. *Tilmadoche nutans* Rost., Mon., p. 127.

γ. **leucophæum** : sporangium-wall with abundant lime, somewhat persistent, capillitium with flat, often perforated expansions at the axils, especially towards the base of the sporangium, lime-knots many or few, fusiform or rounded, 5 to 20 μ diam. ; sessile forms frequent ; stalk erect or cernuous. Spores 8 to 10 μ diam. *P. leucophæum* Fr., Sym. Gast., p. 24.

δ. **robustum** : sporangium-wall with dense deposits of lime, persistent. Capillitium stouter, with wide flat expansions, lime-knots rounded or angular, 20 to 50 μ broad, sometimes confined to the centre of the sporangium and confluent. Plasmodiocarp forms frequent. Stalk short, erect, stout. Spores more distinctly warted, 9 to 11 μ diam.

Plate XV.. A.—*a*. sporangia of form *β*, × 20 ; *b*. capillitium and spores, × 280 ; *c*. spore, × 600 ; *d* and *d*¹. sporangia of form between *β* and *γ*, × 20 ; *e*. capillitium of *d* with abundant lime-knots, × 280 ; *f*. capillitium of *d*¹, with few minute lime-knots, × 280 (England).

B.—*a*. sporangia of form *γ*, × 20 ; *b*. capillitium and spores, × 280 ; *c*. sporangia of form *δ*, × 20 ; *d*. capillitium and spores, × 280 ; *e*. spore, × 600 (England).

The type of *Til. gracilenta* Rost., in the Strassburg collection, has small, nearly globose sporangia of the form *β*, and of a greyish-white

or greyish-violet colour, as given by Rost., Mon., p. 120, and not "fusco-atra" (Sacc., Syll., p. 360). The specimen named *Til. gracilenta* from Sowerby's Herb. (K. 1419) approaches the form δ, with stout dark stalk. *Physarum Readeri* Mass., from Melbourne (K. 500), is the form γ, with spores 8 to 9 μ diam. The type of *P. granulatum* Balf. fil. (K. 67) is the form γ, with the lime on the sporangium-wall in sand-like granules, a not infrequent appearance in species of Physaraceæ (cf. *P. compressum*). *P. Muscicola* Pers. is referred to by Persoon in Syn. Fung. 1801, p. 171, as hardly to be distinguished from the somewhat larger species *P. nutans*; it would therefore appear to be a small form of variety β. *Tilmadoche Pini* Rost., Mon., p. 128, is described as similar to *P. nutans*, but of erect and somewhat larger growth, and more robust.

Hab. On rotten stumps, etc.—Leytonstone, Essex; Lyme Regis, Dorset (L:B.M.28); γ. France (Paris Herb.); α β γ δ. Germany and Poland (Strassb. Herb.); γ. Italy (B. M. 435); γ. Australia (K. 500); β. Tasmania (K. 1403), New Zealand (K. 1243); β and γ. N. America (L:B.M.28).

20. **P. calidris** Lister, in Journ. Bot. 1891, p. 258, Pl. 308, fig. 2. Plasmodium? Total height 1 to 2 mm. Sporangia subglobose, stipitate, erect or somewhat inclined, scattered, 0·5 mm. diam., white, rugose; sporangium-wall membranous, colourless above, with dense clusters of innate white granules; thickened and persistent at the base, partaking of the colour of the stalk. Stalk subulate or equal, furrowed, 1 to 1·5 mm. long, 0·1 mm. thick, red-brown, clear orange-brown in glycerine-jelly mounting, not enclosing refuse matter, or rarely, at the base. Columella none. Capillitium of colourless branching threads with numerous or few white lime-knots; very various in the same development, either delicate or approaching the type of *Badhamia*. Spores pale rownish-violet, almost smooth, 8 to 11 μ diam. — *Didymium usillum* Berk. & Curt., Grev., ii. (1873), p. 53. *Badhamia nodulosa* Mass., Mon., p. 322.

Plate XIV., B.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (England).

The specimen in Broome's Herb. named *P. elephantinum* Berk. & Br. MS. from Ceylon (B. M. 453) is a somewhat larger form, but appears to be the same species, with capillitium and spores similar to those in the English gatherings. *P. nodulosum* Cooke & Balf. (B. M. 858), from South Carolina, differs from the English specimens of *P. calidris* only in the Badhamia-like capillitium. In the Lyme Regis gatherings this character is very inconstant: in one sporangium the hyaline threads may be abundant, either delicate or with broad expansions, and the lime-knots scattered; in another the hyaline threads may be few, with the capillitium consisting chiefly of confluent lime-knots. In the sporangium examined of the Orton specimen (K. 1411) the capillitium, for a great part, consists of a network of broad strands more or less filled with lime, of *Badhamia* type; the remainder has numerous lime-knots connected by delicate hyaline threads. The type of *Didymium pusillum* Berk. & Curt., from South Carolina (K. 1492), consists of specimens on two slips of wood, on one of which are three small sporangia of a *Physarum* with orange translucent stalks, no columella,

and capillitium with white lime-knots, answering to Berkeley's description of *D. pusillum* (Grev., ii., 1873, p. 53) and to that given above of *Physarum calidris*. On the other slip of wood are several specimens of a *Didymium* with orange stalks, crystalline deposits of lime on the sporangium-wall, and a large white columella. These resemble the type and correspond with Berkeley's description of his *D. proximum* (Grev., ii., 1873, p. 52), which is the same species as *D. xanthopus* Fr. Owing to the combination of these two specimens, Rostafinski has given *D. pusillum* as a synonym for *D. proximum*, only noticing the characters of the latter. The first part of Saccardo's description of *D. proximum* (Syll., vii., p. 380) is taken from Berkeley's account of *D. pusillum* in Grevillea, *l.c.*, while the second part is a translation of Rostafinski's account of *D. proximum*; hence a confusion has arisen, and it would be well if the name *D. pusillum* Berk. were dropped, or retained only as a synonym for *P. calidris*.

Hab. On dead leaves, etc.—Lyme Regis, Dorset (L:B.M.29); Luton, Beds. (L:B.M.29); Wothorpe, Northampton (K. 1549); Orton, Leicester (K. 1411); Linlithgow (K. 1504); France (Paris Herb.); Parma (B. M. 496); Ceylon (B. M. 453); S. Carolina (B. M. 858).

21. **P. compressum** Alb. & Schw., Fung. Lus., p. 97 (1805). Plasmodium white, on decayed polyporus, dead leaves, etc. Total height 1 to 1·5 mm. Sporangia reniform or irregularly ovoid, compressed, erect, splitting along the upper ridge; stipitate, sessile, or plasmodiocarps; scattered, closely aggregated or confluent; white or grey, rugose or warted; sporangium-wall membranous, colourless, or purplish below, with dense innate clusters of white lime-granules. Stalk stout, equal, furrowed, black from contained refuse matter, or brownish or white from deposits of lime in the wall, never with chalk-white fracture at the base. Columella none. Capillitium a network formed of very numerous white lime-knots, varying in shape and size, connected by rather short, seldom branching, hyaline threads. Spores dark purplish-brown, more or less spinulose or echinulate, 9 to 14 μ diam.—Sacc., Syll., vii., p. 337. *Physarum nephroideum* Rost., Mon., p. 93, figs. 80-82; Mass., Mon., p. 285. *Physarum candidum* Rost., Mon., p. 96; Mass., Mon., p. 286. *Physarum affine* Rost., Mon., App., p. 5; Mass., Mon., p. 283. *Physarum Phillipsii* Balf. fil., in Grev., vol. x. (1882), p. 116; Mass., Mon., p. 290. *Didymium glaucum* Phill., in Grev., vol. v. (1876), p. 114. *Physarum glaucum* Mass., Mon., p. 284. *Didymium radiatum* Mass., Mon. (in part), p. 229. *Physarum nicaraguense* Macbride, in Bull. Nat. Hist. Iowa, vol. ii., p. 382.

The sporangia of *P. compressum* vary extremely in shape and general appearance, and in some forms resemble those of the following allied species, from which they may be distinguished by the characters as under:—From *P. nutans* by the abundant lime-knots and dark spores; from *P. cinereum*—the sessile forms are separated by the dark spores; from *P. didermoides* by the presence of refuse matter in the stalk and by the single sporangium-wall; from *P. bivalve* by the darker spores and shorter plasmodiocarps.

Much difference is found in the size and roughness of the spores in sporangia from the same cultivation. In some groups they measure

12 to 15 μ, and are strongly spinulose; while in others they are smoother, and average 9 to 11 μ diam. The lime-granules in the sporangium-wall frequently coalesce into vitreous superficial scales or coarse particles, and those in the lime-knots become transparent and lose their granular character. This feature is occasionally, though rarely, met with in other species. In preparations in water of highly calcareous sporangia part of the lime is found to dissolve, and on drying to crystallise on the slide in particles resembling those described. A cultivation from an extensive growth of plasmodium exhibited the forms α, β, and γ in the development of the sporangia.

α. Sporangia ovoid or reniform, laterally compressed, on short black or grey stalks, or sessile.
β. Sporangia ovoid or reniform, on white stalks 0·5 mm. long.
γ. Plasmodiocarps lobed and confluent.
δ. Sporangia subglobose, stipitate.

Plate XVI., A.—*a*. sporangia of vars. α, β, and γ, developed from the same plasmodium, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (England).

B.—*a*. sporangia of vars. α and γ, drawn from the type specimen of *Physarum Phillipsii*, × 20; *b*. capillitium and spores, × 280 (England); *c*. sporangia of var. δ, × 20; *d*. capillitium and spores, × 280; *e*. spores, × 600 (Iowa, B.M. 807).

Plate XVII., A.—*a*. sporangia from type of *P. nicaraguense* Macb., × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (Nicaragua).

The specimens named *P. nephroideum* Rost. (Strassb. Herb.) are the form *a*. The type of *P. candidum* Rost., from Juan Fernandez (K. 510), is the form β; in some of the sporangia the lime-knots coalesce to form a central mass; that of *P. Phillipsii* Balf., from Phillips' Herb., shows the forms α and γ; and that of *P. lividum* var. *conglobatum* Rost., from Ceylon, No. 55 (K. 1244), is the form α with short black stalks; that of *P. affine* Rost., from Cuba, No. 907 (K. 1350), is the form β with white stalks. *Didymium botryoides* Berk. in Herb., from New Zealand (K. 1523)—a type of *D. radiatum* Mass.—is the form *a*. *D. pruinosum* Berk. & Curt., from Cuba (K. 1515), given by Rostafinski as a synonym for *P. nephroideum* (Rost., App., p. 5), is the form *a*. *P. glaucum* Phill., in Phillips' Herb., is form *a* both with short black stalks and sessile. In Berkeley's Herb. there are two gatherings from Ceylon of one species under the name of *P. nutans*: one of these (K. 1406) is the type of *Tilmadoche reniformis* Mass., the other (K. 1407) the type of *Didymium echinospora* Mass. It is a form with compressed reniform sporangia on long buff stalks; capillitium with large fusiform or branching lime-knots and short connecting hyaline threads; spores dark purple-brown, spinose, 13 to 15 μ. It appears to be a variety of *P. compressum*, form *a*, differing from the type in the long slender stalk.

American specimens, with nearly globose sporangia, and buff or white, long or short, stout stalks, from Professors Farlow and Macbride, appear from the capillitium and spores to be *P. compressum*, but a well-marked variety. They are more symmetrical than European forms, and are distinguished as var. δ.

The specimen from Nicaragua named *P. nicaraguense* Macbride (figured on Plate XVII., A.) corresponds with a long-stalked and lobed form of *P. compressum* from Ceylon (B. M. 420), part of which gathering is shortly stalked or sessile; it also approaches a specimen from Luton (L:B.M.30), in which the lobed and confluent sporangia

are seated on short white stalks. The abundant lime in the capillitium and pseudo-columella are varying characters, but are unusually pronounced in this specimen. The spores are purplish-brown, minutely and closely spinulose, 9 to 10 μ diam. Prof. Macbride compares it with *P. glaucum* Phill., a synonym for *P. compressum*, and there does not appear to be any specific character by which it can be separated from that species.

Hab. On dead wood, etc.—Shrewsbury (B. M. 115) ; Hitchin, Herts. (L:B.M.30) ; Linlithgowshire (K. 1499) ; Germany and Poland (Strassb. Herb.) ; Italy (B. M. 423) ; Ceylon (B. M. 419, 420) ; Australia (K. 1314) ; New Zealand (K. 1282) ; δ. New Hampshire (L:B.M.30) ; δ. Iowa (B. M. 806); Texas (K. 1303) ; Cuba (K. 1350) ; Juan Fernandez (K. 510) ; Paraguay (Paris Herb.) ; Nicaragua (B. M. 1010).

22. **P. didermoides** Rost., Mon., p. 97, fig. 87 (1875). Plasmodium ? Total height 0·5 to 1·3 mm. Sporangia ovoid, erect, stipitate or sessile, crowded, about 0·8 mm. high, 0·5 mm. broad, white, or dark grey above from the falling away or discontinuance of the outer calcareous crust ; sporangium-wall of three layers, the outer a dense deposit of white lime-granules, deciduous, the middle layer a delicate colourless membrane with scattered lime-granules, closely combined with an inner purplish, hyaline, areolated, thicker layer. Stalk variable in length and thickness, or wanting, white, membranous, with innate deposits of lime-granules, not containing refuse matter, rising from a plicate white hypothallus. Columella none. Capillitium consisting of numerous rounded or somewhat angular white lime-knots connected by short, seldom branching, hyaline threads, which are purple at the attachments to the sporangium-wall. Spores very dark purple-brown, nearly smooth or minutely spinulose, 10 to 13 μ diam.—Cooke, Myx., p. 11 ; Mass., Mon., p. 291 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 154. *Spumaria ? didermoides* Pers., Syn., Addenda, p. xxix (1801). *Physarum lividum β licheniforme* Rost., Mon., p. 95 ; Mass., Mon., p. 304 (in part). *Physarum cinereum* var. *ovoideum* Sacc., in Michelia, ii., p. 334 ; Sacc., Syll., vii., p. 344 ; Mass., Mon., p. 299.

Plate XIX., A.—*a*. sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall and spores, × 280 ; *c*. spore, × 600 (Italy).

P. cinereum var. *ovoideum* Sacc. on *Ailanthus glandulosa* (B. M. 432) is a short-stalked form of *P. didermoides*, the sporangia arising from a white membranous hypothallus. *P. lividum* var. *licheniforme* Rost., parts of the type of which from Schweinitz' Herb. are in the Strassburg and Kew collections (K. 1249), is a sessile form of *P. didermoides*.

Hab. On dead wood, leaves, etc.—King's Cliff, Norths. (K. 1252) ; Lyons, France (B. M. 432) ; Germany (Paris Herb.) ; Italy (K. 101) ; Natal (K. 8) ; Ceylon (B. M. 420) ; Iowa (B. M. 809) ; N. Carolina (B. M. 998) ; Ohio (L:B.M.31).

23. **P. cinereum** Pers., in Römer, N. Mag. Bot., i., p. 89 (1794). Plasmodium watery white, among dead leaves. Sporangia sessile, subglobose, pulvinate, oblong or plasmodiocarps, scattered or crowded, contorted and confluent, 0·3 to 0·5 mm. broad, white or cinereous, more or less warted or veined; sporangium-wall

membranous with innate clusters of white lime-granules. Columella none, or represented by confluent lime-knots. Capillitium of branching hyaline threads, with numerous white lime-knots varying in size and shape, sometimes confluent in the centre of the sporangium or forming a Badhamia-like network with few hyaline threads. Spores bright violet-brown, almost smooth or spinulose, 7 to 10 μ diam.—Rost., Mon., p. 102, figs. 71, 72, 85; Cooke, Myx. Brit., p. 13; Mass., Mon., p. 298; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 155, Pl. ix., fig. 4. *Lycoperdon cinereum* Batsch, Elench. Fung., p. 155 (1783). *Didymium scrobiculatum* Berk., in Hook. Journ. Bot. (1845), p. 66. *Physarum scrobiculatum* Mass., Mon., p. 300.

Plate XVIII., A.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (England).

Plate XVIII., B.—*a*. sporangia, × 20; *b*. capillitium attached to columella and spores, × 280; *c*. spore, × 600 (Germany, Rostafinski's type of *Crateriachea mutabilis*).

The capillitium of *P. cinereum* varies widely in the development of the lime-knots; in the common forms they are very numerous and rounded. Sometimes they are large and angled, and at other times small with the hyaline threads profuse. They are usually equally distributed among the capillitium, but occasionally more concentrated in the middle of the sporangium. A remarkable instance of the latter state is seen in the form named by Rostafinski *Crateriachea mutabilis* (Mon., p. 126), the type of which is in the Strassburg collection. Here the lime-knots are confluent, forming a distinct columella, a few also appearing among the network of hyaline threads by which it is surrounded. The sporangia are mostly elongated plasmodiocarps with scanty, brownish-yellow hypothallus, but some are ovoid or subcylindrical, erect on a short brown stalk, the brown colour extending into the lower part of the sporangium-wall. The specimen issued by Rabenhorst and Winter from Pavia No. 2969 (B. M. 542), wrongly named *Didymium squamulosum*, resembles *Crateriachea* in the sporangia being occasionally provided with a short brown stalk, and in the lime-knots being confluent and forming a pseudo-columella, but they are less densely compacted and more distributed among the surrounding capillitium; the sporangia are also nearly globose. In the form named by Cesati *Didymium Neapolitanum* (B. M. 573),* the lime-knots are confluent, forming a large central mass more or less attached to the base of the sporangium; the surrounding capillitium either consists almost exclusively of hyaline threads, or has a few large scattered lime-knots in addition; the sporangia are irregularly globose, sessile, or on a buff foot-like hypothallus; the spores in these three specimens are the same as in *P. cinereum*. How far *Crateriachea mutabilis*, *Didymium Neapolitanum*, and the Pavia specimen above mentioned may be held to be varieties of *P. cinereum*, or as distinct species, must depend on further gatherings establishing the constancy of their forms; as the occasional aggregation of lime-knots is of frequent occurrence in other species of *Physarum*, and in the somewhat nearly allied *Badhamia panicea*, this character can scarcely be considered important. It appears from

* Two species were issued by Rabenhorst and Winter under the name *Didymium Neapolitanum* Ces., No. 2675; that in the Kew coll. (557) is *D. squamulosum*, that in the British Museum (573) is the species above described.

Berkeley's description of *Didymium scrobiculatum* that Rostafinski was right in placing it under *P. cinereum*. There is nothing remaining of the type specimen in Berkeley's Herb. (K. 1518).

Hab. On dead leaves, etc.—Lyme Regis, Dorset (L:B.M.32) ; Leytonstone, Essex (L:B.M.32) ; France (Paris Herb.) ; Germany (Strassb. Herb.) ; Natal (K. 2) ; Ceylon (K. 1284) ; Madras (K. 17) ; Pennsylvania (L:B.M.32) ; Iowa (L:B.M.32) ; S. Carolina (B. M. 428, 431, 885, 934) ; Cuba (B. M. 429) ; Paraguay (K. 502).

24. **P. bivalve** Pers., in Usteri, Ann. Bot., xv., p. 5 (1795). Plasmodium white, among dead leaves. Sporangia sessile, elongated, laterally compressed, sinuous or branched, equal in breadth from the base to the flattened ridge, which at length splits longitudinally ; sometimes pulvinate, bursting irregularly ; white, grey, or yellowish ; sporangium-wall double, the outer layer with copious deposits of lime, smooth or reticulated, the inner wrinkled and colourless, showing as a grey membrane along the line of dehiscence, adhering to the outer layer below. Columella none. Capillitium a network formed of numerous white, often branching lime-knots, varying in shape and size, connected by rather short hyaline threads. Spores violet-brown, spinulose, 8 to 10 μ diam.—*Reticularia sinuosa* Bull., Champ., p. 94, Pl. ccccxlvi., fig. 3 (1791). *Angioridium sinuosum* Grev., Scot. Crypt. Fl., t. 310. *Diderma valvatum* Fr., Syst. Myc., iii., p. 109. *Physarum sinuosum* Fr., Syst. Myc., iii., p. 145 ; Rost., Mon., p. 112, fig. 91 ; Cooke, Myx. Brit., p. 14 ; Mass., Mon., p. 305 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 157.

Plate XIX., B.—*a*. sporangium, × 20 ; *b*. capillitium with fragment of sporangium-wall and spores, × 280 ; *c*. spore, × 600 (England).

Forms without lime occur occasionally in *P. bivalve* and the allied species.

Hab. On dead leaves, etc.—Portbury, near Bristol (B. M. 116, 117) ; Leytonstone, Essex (L:B.M.33) ; Luton, Beds. (L:B.M.33) ; France (K. 28) ; Germany (B. M. 510) ; Finland (B. M. 450) ; Bohemia (B. M. 446) ; Poland (Strassb. Herb.) ; Italy (K. 1345) ; Ceylon (B. M. 451) ; Java (K. 1312) ; Brisbane (B. M. 535) ; Iowa (B. M. 811) ; S. Carolina (B. M. 932, 933, 934).

25. **P. Diderma** Rost., Mon., p. 110 (1875). Plasmodium white. Sporangia subglobose, 0·6 to 0·8 mm. diam., sessile ; or curved and flexuose plasmodiocarps 2 to 6 mm. long, rounded, not compressed, smooth, white or buff ; sporangium-wall double, the outer wall densely charged with white lime-granules, free and deciduous above, recurved and persistent below ; inner wall smooth, membranous, persistent, of two layers, the outer thin and colourless, combined with the purplish inner layer. Columella none. Capillitium a network of hyaline threads, with numerous, variously shaped large white lime-knots. Spores dark purplish-brown, spinulose, 10 to 12 μ diam.—Mass., Mon., p. 304 ; List., in Journ. Bot. 1891, p. 260, Pl. 309, fig. 2.

Plate XXII., A.—*a*. sporangia, × 20 ; *b*. capillitium with fragment of sporangium and spores, × 280 ; *c*. spore, × 600 (England).

The uncompressed sporangia with the outer wall nearly free from the smooth purplish inner wall characterises this species, and distinguishes it from *P. bivalve* and *P. compressum*, its nearest allies.

Hab. On dead leaves, etc.—Wanstead, Essex (L:B.M.34); Flitwick, Beds. (L:B.M.34); Germany (B. M. 512).

26. **P. contextum** Pers., Syn., p. 168 (1801). Plasmodium yellow. Sporangia subglobose, ovoid, erect, 0·4 to 0·6 mm. diam., sessile or reniform and elongated on a broad base, crowded, often angled by mutual pressure, rounded or flattened above, smooth, yellowish-white or ochraceous; sporangium-wall double, the outer layer thick with dense deposits of lime, often breaking away in the upper part from the thin colourless inner layer. Columella none. Capillitium with scanty hyaline threads and numerous large irregularly branching white lime-knots. Spores dark violet-brown, spinulose, 10 to 13 μ diam.—Rost., Mon., p. 109; Cooke, Myx. Brit., p. 13; Mass., Mon., p. 303 (in part); Macbride, in Bull. Nat. Hist. Iowa, ii., p. 157. *Diderma contextum* Pers., Obs. Myc., i., p. 89 (1796); Fr., Syst. Myc., iii., p. 111. *Diderma ochroleucum* Berk. & Curt., in Grev., ii., p. 52. *Physarum conglomeratum* Mass., Mon., p. 304.

Plate XX., A.—*a.* sporangia of two forms, × 20; *b.* capillitium and spores, × 280; *c.* spore, × 600 (Germany: Rostafinski's type).

The type of *Diderma ochroleucum* Berk. & Curt., from Pennsylvania (K. 1533), is typical *P. contextum*.

Hab. On dead leaves, sticks, etc.—Lyme Regis, Dorset (L:B.M.35); near Birmingham (L:B M.35); France (K. 365); Germany (B. M. 418); Sweden (K. 1277); Poland (Strassb. Herb.); Iowa (B. M. 808); Mass., U.S.A. (L:B.M.35).

27. **P. conglomeratum** Rost., Mon., p. 108, figs. 73, 79, 90 (1875). Plasmodium? Sporangia subglobose, sessile on a broad base, densely aggregated on one plane, angled by mutual pressure, 0·3 to 0·5 mm. broad, yellow or brownish-white, mottled with paler shades; sporangium-wall double, the inner layer of the convex upper wall having translucent, pale yellow, curved, thickened areas, with a vitreous fracture; the outer layer thick, consisting of easily crumbling yellow lime-granules; the wall below thin with the two layers less distinct. Capillitium of delicate branching hyaline threads, with numerous white or yellowish, branching, often confluent lime-knots. Spores pale violet-brown, almost smooth, 8 to 10 μ diam.—List., in Journ. Bot. 1891, p. 259, Pl. cccviii., fig. 1. *Diderma conglomeratum* Fr., Syst. Myc., iii., p. 111 (1829). *Physarum Rostafinskii* Mass., Mon., p. 301.

Plate XX., B.—*a.* sporangia, × 20; *b.* capillitium, with fragment of sporangium-wall, showing vitreous structure (b^1) and spores, × 280; *c.* spore, × 600 (Germany: Rostafinski's type).

Distinguished from *P. contextum* by the pale, nearly smooth, and smaller spores, and by the vitreous structure of the inner wall of the upper part of the sporangium. Rostafinski's type specimens of *P. conglomeratum* from Germany (Strassb. Herb.) and from Sikkim

(B. M. 416 ; K. 96) correspond with the description in his Monograph, but in both of them the lime-knots, though somewhat confluent in the centre of the sporangium, cannot be said to form a cylindrical columella, such as he describes. The specimen from Fries (K. 1277) taken as the type of this species by Massee (Mon., p. 304) is typical *P. contextum* in all the characters given by Rostafinski. The name *P. Rostafinskii*, which is given by Massee as superseding *P. conglomeratum* Rost., is unnecessary. The vitreous structure of the inner wall of the upper part of the sporangium is constant in all the specimens I have examined. Fries distinguished *Diderma conglomeratum* from *D. contextum* chiefly by the difference of the capillitium ; he describes the presence of a columella in both species, but speaks of the deposits of lime as being more largely developed in *D. conglomeratum*. This is an uncertain character, and varies in different gatherings. Rostafinski was the first to detect the main specific difference, and pointed out that in *Physarum contextum* the spores are rough and measure 10 to 13 μ, while in *P. conglomeratum* they are nearly smooth and measure 8 to 9 μ diam. He follows Fries in referring to a columella in *P. conglomeratum*, but adds that it is free and not always evident, and he describes *P. contextum* as being usually without a columella.

Hab. On dead leaves, moss, etc.—Darenth, Kent (B. M. 417) ; Hutton, Yorks. (L:B.M.36) ; Germany (B. M. 415) ; Sikkim, India (B. M. 416).

28. **P. virescens** Ditm., in Sturm, Deutsch. Fl. Pilze, vol. i., p. 123, Pl. lxi. (1817). Plasmodium lemon-yellow, among dead leaves and grass. Sporangia subglobose or irregularly ovoid, 0·2 to 0·8 mm. broad, sessile, much aggregated in confluent groups, or gregarious, rugose or nearly smooth, pale yellowish-green, yellow, or olive-brown from the absence of lime ; sporangium-wall membranous, with dense innate clusters of minute yellow lime-granules, rarely without lime. Columella none. Capillitium a network of hyaline threads ; lime-knots fusiform, roundish or irregular, yellow. Spores minutely spinulose, pale violet-brown, 6 to 9 μ diam.—Rost., Mon., p. 103 ; Cooke, Myx. Brit., p. 13 ; Blytt, Bidr. Norg., Sop. iii. (1892), p. 4 ; Mass., Mon., p. 277. *P. Ditmari* Rost., Mon., App., p. 8 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 155. *P. thejoteum* Fr., Symb. Gast., p. 21 (1818). *Didymium sinapinum* Cooke, Myx. Brit., p. 33 ; Mass., Mon., p. 246. *Physarum auriscalpium* Macbride (non Cooke), *l.c.*, p. 158.

α. **genuinum**: sporangia irregularly ovoid, 0·2 to 0·3 mm. broad, in dense clusters of 20 to 30, on a membranous hypothallus, shading from pale yellow-green to orange-yellow ; sporangium-wall with dense innate clusters of yellow lime-granules. Capillitium often scanty. Spores 7 to 10 μ diam.

β. **obscurum** : sporangia subglobose, 0·4 to 0·6 mm. diameter, sessile, solitary, confluent, or plasmodiocarps, gregarious or crowded, smooth or rugose, greenish, grey, or olive-brown and somewhat glossy ; sporangium-wall membranous, colourless above, yellow at the base, without lime, or with widely scattered innate clusters of whitish lime-granules. Spores 6 to 8 μ diam.

γ. **nitens** : sporangia subglobose, 0·5 to 0·8 mm. diam., sessile, gregarious, not clustered, bright yellow. Spores 7 to 9 μ diam.

Plate XXI., A.—*a.* sporangia, var. *α*, × 20; *b.* capillitium, with fragment of sporangium-wall showing calcareous discs, and spores, × 280; *c.* spore, × 600 (England).

B.—*a.* sporangia, var. *β*, × 20; *b.* capillitium and spores, × 280 (England).

Glycerine mountings of *a. genuinum* show, dispersed in the sporangium-wall, flattened disc-shaped crystalline bodies with a radiating structure, measuring 10 to 20 *μ* diameter, such as are also found in the sporangium-wall of *P. psittacinum* and *Craterium leucocephalum*. They do not appear to be present in vars. *β* and *γ* of *P. virescens*. *Didymium terrigenum* Berk. & Curt., from Carolina (B. M. 575), is given by Rost. as a synonym for *Physarum cinereum* Rost., Mon., App., p. 9. The specimen is in a poor condition, but the character of the sporangia and spores and the orange-yellow lime-knots places it under *P. virescens*. The specimen from Iowa (B. M. 1011), to which Prof. Macbride applied the name *P. auriscalpium* Cooke (*l.c.*), is *P. virescens γ nitens*.

Hab. On dead leaves, grass, etc.—*a.* Epping Forest, Essex (L:B.M. 37). *β.* Lyme Regis, Dorset (L:B.M.37); *a.* France (Paris Herb.); *a.* Germany (B. M. 413); *β.* Hungary (K. 1529); *a.* Dorfhalden (B. M. 861). *γ.* Maine (L:B.M.37); *a.* Massachusetts (L:B.M.37); *γ.* Iowa (B. M. 1011).

29. **P. inæquale** Peck, in Rep. N. York Mus. Nat. Hist., xxxi., Bot., p. 40 (1879). Plasmodium? Sporangia subglobose, 0·3 to 0·7 mm. diam., sessile, or elongated and confluent forming plasmodiocarps, gregarious, yellowish-red, brick-red, rosy-red, or when little lime is present pale bluish spotted with red, somewhat rugose, rupturing irregularly; sporangium-wall membranous, colourless above, yellow at the base, with innate clusters of red or yellow lime-granules. Columella none. Capillitium a network of delicate hyaline colourless or pale yellow threads, with rounded lime-knots varying in shape and size, each knot with a red centre surrounded by yellow round lime-granules 1 to 3 *μ* diam. Spores pale violet-brown, almost smooth, 6 to 9 *μ* diam.—*Didymium lateritium* Berk. & Rav., in Grev., ii. (1873), p. 65. *Physarum Ditmari γ lateritium* Rost., Mon., App., p. 9. *Didymium croceoflavum* Berk. & Br., in Linn. Journ., xiv. (1875), p. 84. *Physarum Ditmari β croceoflavum* Rost., Mon., App., p. 9. *Physarum chrysotrichum* Mass., Mon., p. 300 (in part).

Plate XXII., B.—*a.* sporangia, × 20; *b.* capillitium with fragment of sporangium-wall and spores, × 280; *c.* spore, × 600 (S. Carolina: Berkeley's type of *D. lateritium*).

Intermediate between *P. rubiginosum* and *P. virescens*; from orange forms of the latter it differs in the scattered habit of its sporangia, and from both species in the curious structure of the rounded lime-knots.

Hab. On dead leaves, wood, etc.—Ceylon (B. M. 414); Georgia, U.S.A. (B. M. 898); S. Carolina (B. M. 898, 899); Philadelphia (L:B.M.38); Ohio (L:B.M.38).

30. **P. rubiginosum** Fries, Symb. Gast., p. 21 (1817). Plasmodium? Sporangia subglobose, 0·5 to 0·8 mm. diam., sessile, gregarious or crowded, smooth or rather rough, orange or deep

red or reddish-brown. Sporangium-wall membranous, with dense innate clusters of orange lime-granules. Columella none. Capillitium a network of hyaline threads with frequent triangular membranous expansions at the axils of the branches; lime-knots angular, branching, often confluent, orange-red or orange-brown. Spores pale violet-brown, spinulose, 8 to 11 μ diam.—Rost., Mon., p. 104; List., in Journ. Bot. 1891, p. 259, Pl. 308, fig. 2; Mass., Mon., p. 302; Blytt, Bidr. Norg., Sop. iii., p. 4.

Plate XXIII., A.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (Germany: Rostafinski's type).

B.—*a*. sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (S. Carolina: Cooke's type of *P. auriscalpium*).

The specimen sent by Mr. Wingate to Mr. Massee under the name *Leocarpus squamulosus* (L:B.M.38) so closely resembles *P. rubiginosum* that it appears to be an American form of that species; it agrees with the Strassburg type in the capillitium and spores, and differs only in the more glossy sporangia, which are brown in colour instead of deep red. Two other specimens are difficult to locate. One from Dr. Harkness, Blue Cañon, California (L:B.M.38), named in Phillips's coll. *Badhamia inaurata*, has subglobose sporangia 1 to 1·3 mm. diam.; the sporangium-wall is scaly, and pale yellow with a faint reddish tinge; the capillitium is a network of hyaline threads, with abundant large, branching, pale yellow lime-knots; the spores measure 8 to 10 μ diam. The other from Aiken, S. Carolina, named in Ravenel's collection *Cienkowskia reticulata* (B. M. 991), is a deep orange branching plasmodiocarp; capillitium a network of hyaline threads, with large, branching, pale yellow lime-knots; spores 7 to 9 μ diam. This specimen has a strong external resemblance to *Cienkowskia reticulata*, but it has not the rigid yellow hyaline capillitium threads with hooked branchlets and the flat lime-plates of that species. Should further gatherings confirm the characters of these two specimens they might deserve specific rank, but at present they are retained under *P. rubiginosum*, to which, notwithstanding the pale colour of the lime-knots, they appear to be most nearly allied.

The specimen B. M. 863 is part of the type of *Physarum auriscalpium* Cooke; another part is in the Kew Herb. It is numbered 1854 in Ravenel's collection from the Santee Canal, South Carolina, and was described in Myx. U.S.A., Ann. Lyc. N. H. New York, vol. xi. (1877), p. 384. It presents the following characters:—Sporangia sessile, or with an almost obsolete stalk; subglobose depressed, gregarious, orange red; sporangium-wall of two layers, the outer densely charged with orange lime-granules and separating in scales from the membranous grey inner layer; columella none; capillitium of large, branching orange lime-knots, with few connecting hyaline threads. Spores dull violet brown, minutely warted, 10 to 12 μ diam. The specimen represents a single gathering, and the point in which it differs chiefly from *Physarum rubiginosum* Fries is the Badhamia-like capillitium, but judging from Dr. Cooke's description it would appear that in the sporangia examined by him the hyaline threads were sufficiently developed to include the species in the genus *Physarum*; in other respects there are no characters by which it can be defined as distinct from *P. rubiginosum*, and, provisionally at least, it appears better to place it as a form of the latter species.

Hab. On dead wood and leaves.—Birmingham (L:B.M.39); Germany (Strassb. Herb.); Norway (Christiania Herb.); Philadelphia (L:B.M.39). S. Carolina (B. M. 863, 991); California (L:B.M.39).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

31. **P. flavum** Fries, Symb. Gast., p. 22. Sporangia globose, rugoso-verrucose, yellow. Stalk short, equal, of the length of the sporangium, much wrinkled, pale yellow. Columella none. Capillitium abundant, with large, angular, whitish or pale yellowish lime-knots. Spores dull violet, minutely warted, 9·9 to 10·8 μ diam.—Rost., Mon., p. 100. *Craterium flavum* Fr., Summ. Veg., p. 454.

Hab. On twigs of bramble, ferns, etc.—Sweden.

This description applies to *Craterium citrinellum* List.

32. **P. sulphureum** Alb. & Schw., Consp. Fung., p. 93, tab. 6, fig. 1. Sporangia globose, erect, rugoso-squamulose, sulphur-yellow. Stalk smooth, short, conical, white, densely charged with lime within. Columella none. Capillitium well developed, pale violet-yellow; lime-knots abundant, angular. Spores bright violet, smooth, 10 to 12 μ diam.—Rost., Mon., p. 101.

Hab. On dead leaves.—Germany and Russia.

33. **P. effusum** Schwein., in Trans. Amer. Phil. Soc., iv. (1834), p. 257. Sporangia creeping, forming a reticulation, or entirely effused, white, much flattened; mass of spores and capillitium becoming black.

Hab. On earth in a hothouse.—Salem, N. America.

34. **P. elegans** Schwein., *l.c.* Sporangia crowded, subglobose, convex, flattened above, amethyst colour, subrugose. Spores blackish-brown, conglomerated. Capillitium of thickish threads.

Hab. Rare.—Salem, N. America.

35. **P. luteovalve** Schwein., *l.c.* Sporangia irregularly lobed, convex, more or less confluent, externally of a bright gold colour, somewhat compressed, bivalved. Spores bright yellow.

Hab. On fallen stems.—Carolina.

This might refer to some species of *Perichæna*.

36. **P. polyædron** Schwein., *l.c.* Sporangia gregarious or somewhat scattered, rather large, blackish-fuliginous, dull, subhemispherical, exactly pentagonal with straight sides, rugose, at length breaking in a somewhat stellate manner from the persistent lower part. Spores and dense capillitium of the same colour as the sporangia.

Hab. On logs of walnut.—Bethlehem, N. America.

37. **P. cæspitosum** Schwein., *l.c.*, p. 258. Sporangia substipitate or suddenly contracted at the base, clustered or scattered, tur-

binato-ovate, with yellow scales. Capillitium yellow. Spores blackish-brown.

Hab. On leaves and stalks of rhododendron.—Bethlehem, N. America.

This description would apply to *P. virescens* Ditm.

38. **P. Schroeteri** Rost., Mon., p. 419. Sporangia stipitate, hemispherical, flattened, greenish-grey. Stalk thick, conical, dull yellow or golden, shining, continued into a distinct obtuse conical columella. Capillitium of delicate threads, forming a dense network provided with lime-knots. Spores violet, delicately spinulose, 10 to 11 μ diam.

Hab. Otterdorf, near Rastatt; Dr. Schroeter.

This description points to a form of *P. citrinum*.

39. **P. Famintzini** Rost., Mon., p. 107. Sporangia sessile, minute, crowded, sometimes confluent, dull chestnut, irregularly hemispherical, dehiscing at the apex. Columella none. Capillitium elastic, elongated after dehiscence; the greater part of the knots not developed, a few containing milky yellow lime-granules. Spores pale violet, smooth, 10 μ diam.

Hab. On twigs in Poland.

40. **P. capense** Rost., Mon., p. 113, fig. 92. Sporangia irregularly hemispherical or turbinate, sessile, simple, or more often collected in small clusters on a copious hypothallus, greyish-white, wrinkled. Columella none. Capillitium abundant, with few more or less rectangular lime-knots with very long connecting hyaline threads. Spores pale violet, smooth, 11 to 14 μ diam.

Hab. On branches.—Cape of Good Hope. Specimen in the Leipsic Museum.

The figure and description apply to a form of *P. cinereum*.

41. **P. Braunianum** de Bary, in Rost., Mon., p. 105. Plasmodium yellow; sporangia irregularly globose, small, sessile, simple, or collected in little heaps, brown, 6·5 mm. diam., dull or shining above; sporangium-wall yellowish brown above, dull brown towards the base. Columella none. Capillitium well developed, with small rounded-angular brown lime-knots weakly developed. Spores violet, smooth, 10·7 μ diam.

Hab. Grundewald, near Berlin.—A. Braun.

The nearest allies of this species seem to be *P. murinum* and *P. virescens* var. *obscurum*.

42. **P. ornatum** Peck, in Rep. N. York Mus., xxxi., p. 40. Sporangia depressed or hemispherical, plane or slightly concave beneath, greenish-cinereous, dotted with small yellow granules, the empty walls whitish. Stem short, black or blackish-brown, generally longitudinally wrinkled when dry. Columella none. Capillitium with numerous yellow knot-like thickenings. Spores globose, smooth, violet-brown in the mass, about 10 to 11 μ diam.

Hab. Decaying wood.—Albany, U.S.A.

This description applies to the pale form of *P. viride* Pers.

43. **P. luteolum** Peck, in Rep. N. York Mus., xxx., p. 50, Pl. ii., figs. 15-18. Sporangia small, closely gregarious, sessile, yellowish inclining to tawny, rupturing irregularly; flocci abundant, yellowish-white. Spores globose, purplish-brown, 10 μ diam.

Hab. On the living leaves of *Cornus Canadensis* L.—Adirondack Mts., N.Y.

This description suggests a form of *P. virescens* Ditm.

44. **P. imitans** Racib., in Rozpr., Mat.-Przyr. Akad. Krak., xii., p. 73 (1884), fig. 3 *a b*. Sporangia hemispherical, umbilicate, greyish-white, erect or nodding, with the stalk 1 mm. high. Stalk a little longer than the sporangia, rigid, subulate, brownish-black. Columella none. Capillitium white, abundant, forming an irregular net; nodes sometimes filled with lime, of various shapes. Spores violet, minutely warted, 9·5 to 10 μ diam.—Sacc., Syll., vol. vii., p. 348.

Hab. On branches.—Poland.

Var. **flexuosum** Racib., Hedw., vol. xxviii., p. 120. Plasmodiocarps vermiform. Capillitium of the type of *P. leucophæum*, from which it differs in the distinctly warted spores.

The spores of *P. leucophæum* vary in the extent to which they are warted, but are never quite smooth under a magnification of 1200 diam. The description of *P. imitans* applies to that species.

45. **P. chlorinum** Cooke, in Grev., v., p. 101, pl. 86, fig. 10. Sporangia scattered or gregarious, small, sessile, subglobose, greenish-yellow, simple, bursting in a stellate manner. Spores subglobose, black, opaque, 8 to 9 μ diam.

Hab. On dead wood of *Cocos nucifera* L.—Demerara.

In the absence of a type specimen, this description is too brief to be serviceable.

SPECIES REFERRED TO *TILMADOCHE* NOT MET WITH IN THE QUOTED COLLECTIONS.

46. **T. anomala** Mass., Mon., p. 333. Gregarious; sporangia globose or slightly depressed, minutely umbilicate beneath, white, sprinkled with minute particles of lime; stem elongated, slender, equal, straight, pale yellow, longitudinally wrinkled, filled with particles of lime, expanding at the base into a minute circular hypothallus. Capillitium rather dense; threads everywhere equal, about 3 μ thick, combined to form a loose irregular network. Nodes very rarely slightly incrassated, and containing a few minute, colourless granules of lime; spores globose, dirty lilac, smooth, 10 μ diam.

Hab. On wood.—Venezuela.

47. **T. cavipes** Berk., in Grev., xi., p. 39. Mycelium reticulate, white sporangia, when young, flesh-colour, afterwards brick-red,

pulverulent, globose; stalks white, thickened at the base, cottony, hollow; spores purple-black, smooth, globose. Capillitium scanty, yellow.

Hab. On leaves of *Phalænopsis*.—Andaman Isles.

The filmy reticulate mycelium at length disappears, and the peridia are scattered, looking at first sight, from their white stems, like *Diachæa*. The species is altogether distinct from *Trichia lateritia* Lev. The dust of the peridia consists of irregular fragments of a bright orange-red.

SPECIES EXCLUDED FROM THE GENUS.

P. cerebrinum Mass.	= *Fuligo septica* Gmel.
P. chrysotrichum Berk. & Curt.	= *Badhamia decipiens* Berk. & Curt.
P. citrinellum Peck.	= *Craterium citrinellum* List.
P. concinnum Mass.	= *Badhamia lilacina* Rost.
P. ellipsosporum Rost.	= *Fuligo ellipsospora* List.
P. gyrosum Rost.	= *Fuligo septica* Gmel.
P. gyrosum Mass. (in part)	= *Badhamia decipiens* Berk. & Curt.
P. hians Mass.	= *Physarella mirabilis* Peck.
P. muscorum A. & S.	= *Fuligo septica* Gmel.
P. rufibasis Berk. & Br.	= *Physarella mirabilis* Peck.
P. scyphoides Cooke & Balf.	= *Craterium leucocephalum* Ditm.

The following species of *Physarum* are rejected by Rostafinski on sufficient grounds (Rost., Mon., p. 304):—

P. antiades Fr.
P. atrum Fr.
P. connatum Schum.
P. elongatum Link.
P. flavo-virens A. & S.
P. fimetarium Schum.
P. hypnophilum Fr.
P. piceum Fr.
P. purpurascens Link.
P. stipitatum Chev.
P. villosum Schum.

Genus 4.—**FULIGO** Haller, Hist. Stirp. Helv., iii., p. 110 (1768). Sporangia elongated, branching and interwoven, combined into a pulvinate or effused æthalium; the outer layer forming a cortex charged with deposits of lime-granules, without spores; the inner stratum containing the spores and a well-developed capillitium, with few or many lime-knots; the lower layer forming a skin-like hypothallus.

KEY TO THE SPECIES OF *FULIGO*.

Æthalia and lime-knots yellow or variously coloured :—
Spores nearly smooth, 7 to 10 μ diam. (1) *F. septica*
Spores spinulose, 10 to 11 μ diam. (2) *F. ochracea*
Æthalia and lime-knots pure white. (3) *F. ellipsospora*

1. **F. septica** Gmelin, Syst. Nat., p. 1466 (1791). Plasmodium yellow. Æthalia pulvinate, varying much in size, from 2 mm. to 20 cm., broad, yellow, pinkish or dull white or reddish-brown. The sporangia constituting the æthalium are intricately coiled and anastomosing, 2 to 2·5 mm. broad, with air spaces in the intervals which permeate the mass. The cortex is sometimes wanting, when the surface is grey and marked with brain-like convolutions. Sporangium-walls within the æthalium membranous, very fragile, colourless, with scattered deposits of lime-granules. Columella none. Capillitium very variable, a loose network of slender hyaline threads more or less expanded at the axils, with rounded, fusiform, or branching yellow or whitish lime-knots, varying much in size. Spores violet, almost smooth, 6 to 10 μ diam.—Blytt, Bidr. Norg., Sop. iii. (1892), p. 5. *Mucor septicus* Linn., Sp. Pl., Ed. 2, p. 1656 (1763). *Fuligo varians* Somm., Fl. Lap., p. 239; Rost., Mon., p. 134; Cooke, Myx. Brit., p. 23; Mass., Mon., p. 340; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 160. *Æthalium septicum* Fr., Syst. Myc., iii., p. 93; Cooke, Handbook, No. 1101. *Physarum gyrosum* Rost., Mon., p. 111. *Physarum cerebrinum* Mass., Mon., p. 306. *Licea Lindheimeri* Berk., in Grev., ii., p. 68. *Tubulina Lindheimeri* Mass., Mon., p. 42.

Plate XXIV., A.—*a*. a small part of an ecorticate æthalium, nearly resembling the type of *Physarum gyrosum* Rost., × 20; *b*. capillitium with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (England); *d*. capillitium and subellipsoid spores from a corticate æthalium, × 280 (Black Forest, Germany).

Rostafinski's type specimen of *Physarum gyrosum* Rost. from Berlin in the Strasburg collection consists of minute pinkish æthalia of *Fuligo septica* 2 to 3 mm. broad, without superficial cortex. He quotes *Reticularia muscorum* Fr. (Syst. Myc., iii., p. 91), as a synonym for *P. gyrosum*; it appears probable from Fries' description that his species was also a small ecorticate form of *F. septica*. In the type specimen of *Licea Lindheimeri* Berk. from Texas (K. 1648) only the basal part of an æthalium remains; it is an orange form of *Fuligo septica* with scanty delicate capillitium and violet spores measuring 5 to 7 μ. The type of *Physarum cerebrinum* Mass., produced in a hothouse at Kew (K. 195), is also a form of *F. septica* with no cortex developed over the convoluted sporangia; it is found that if the rising plasmodium is protected by a bell-glass from currents of dry air, the outer sporangia develop as well as the inner, and no cortex of barren sporangia is formed.

Hab. On rotten wood, tan, etc.—Common. Leytonstone, Essex; Lyme Regis, Dorset (L:B.M.40); Highgate (B. M. 155); Europe (B. M. 461, 463); South Africa (K. 232); Australia (B. M. 468); New Zealand (K. 201); N. America (B. M. 813).

2. **F. ochracea** Peck, in Rep. N. York Mus. Nat. Hist., xxxi., Bot., p. 56 (1879). Plasmodium vitelline-yellow (teste Dr. Rex). Æthalia pulvinate, 2 mm. to 1 cm. broad, formed of very closely interwoven sporangia, the cortex delicate and membranous or hardly developed, yellowish grey or grey, with scattered deposits of yellow lime-granules. Capillitium of numerous fusiform or branching yellow lime-knots connected by rather short hyaline threads. Spores violet-brown, spinulose, 10 to 11 μ diam.—Mass., Mon., p. 342. *Licea ochracea* Peck, in Rep. N. York Mus. Nat. Hist., xxviii. (1875).

Plate XXIV., A.—*e*. capillitium and spores, × 280; *f*. spore, × 600 (United States).

Very closely allied to *Fuligo septica*, from which it differs in the short hyaline threads of the capillitium and the larger rougher spores.

Hab. On rotten wood.—Pennsylvania (L:B.M.41).

3. **F. ellipsospora** Lister. Plasmodium ? Æthalia pulvinate, elongate, 4 to 6 mm. long, or irregular and effused, formed of closely interwoven sporangia enclosed in a smooth white cortex densely charged with lime, continuous with the white hypothallus. Sporangium-walls within the æthalium more or less perfect, membranous, with deposits of white lime-granules. Columella none. Capillitium of large white lime-knots connected by simple or branching hyaline threads. Spores brownish-violet, spinulose, ellipsoid, 13 to 17 × 10 to 12 μ.—*Physarum ellipsosporum* Rost., Mon., App., p. 10; Mass., Mon., p. 310; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 158. *Enteridium cinereum* Schwein., in Trans. Am. Phil. Soc., new ser., iv., p. 261. *Badhamia coadnata* Rost., Mon., p. 146; Mass., Mon., p. 325.

Plate XXIV., B.—*a*. æthalia, × 5; *b*. æthalium, × 20; *c*. capillitium and spores, × 280; *d*. spore, × 600 (United States).

The type specimen of *Badhamia coadnata* Rost. from Cuba in the Strassburg collection is similar to the American specimens of *F. ellipsospora*; the large branching lime-knots are connected by very short hyaline threads. The account given by Zopf of *Æthaliopsis stercoriformis* Zopf (Pilzthiere, p. 150, 1884, syn. *Fuligo stercoriformis* Mass., Mon., p. 342) so well describes *F. ellipsospora* that they appear to be the same species.

Hab. On dead leaves, etc.—Iowa (B. M. 810); Ohio (L:B.M. 42); S. Carolina (B. M. 845); Cuba (Strassb. Herb.).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

4. **F. tatrica** Racib. in Hedw. 1885, p. 169, on decaying trunks in Hungary, is described as differing from *F. septica* in having minutely spinulose spores. This does not constitute a specific distinction, as the spores of *F. septica* vary slightly in roughness, and are seldom quite smooth when magnified 1200 diam.

5. **F. simulans** Karst., in Bidr. Känn. Finl. Nat., xxxi., 108 (1879), on leaves of *Vaccinium Vitis-idæa* L. in Finland, is

described as being similar to *F. septica*, but with darker spores (violet-black or almost black), 9-16 μ, average 10 μ; according to Raciborski it is a form of the latter species (see Hedw. 1887, p. 111). The character of the spores appears to place it rather under *F. ochracea*.

Genus 5.—**CIENKOWSKIA** Rostafinski, Versuch, p. 9 (1873). Sporangium-wall cartilaginous at the base; capillitium a loose network of rigid threads with many free, curved, sharp-pointed branchlets, connected with flat perforated calcareous plates attached at their margins to the sporangium-wall.

1. **C. reticulata** Rost., Versuch, p. 9 (1873). Plasmodium? Sporangia consisting of winding branched cylindrical plasmodiocarps, sometimes forming a net, attached by a narrow basal keel to the substratum; 0·5 mm. diam., yellow-brown with transverse pale ridges, blotched with crimson; sporangium-wall orange-yellow, membranous above, cartilaginous below, marked with the bases of the calcareous plates of the capillitium. Columella none. Capillitium consisting of flexuose, branching, rigid, yellow hyaline threads, irregularly anastomosing, with numerous free sharp-pointed uncinate branchlets, and of lime-deposits in the form of flat, perforated, pale yellow plates disposed transversely to the axis of the sporangium and connected by broad or narrow attachments to the sporangium-wall; occasionally with irregular lime-knots intermixed. Spores clear violet-brown, minutely spinulose, 9 to 11 μ diam.—Rost., Mon., p. 91; Cooke, Myx. Brit., p. 11, fig. 107; Mass., Mon., p. 337. *Physarum reticulatum* Alb. & Schw., Consp. Fung., p. 90 (1805).

Plate XXV., A.—*a*. plasmodiocarp, × 2; *b*. portion of plasmodiocarp, in part broken, and showing the parallel plates of lime among the spores, × 20; *c*. capillitium and spores, × 280; *d*. spore, × 600 (Sibbertoft, England).

Hab. On dead wood.—Sibbertoft, Leicestershire (L:B.M.43); France (Edin. Herb.); Germany (Strassb. Herb.); Java (K. 1772).

Genus 6.—**PHYSARELLA** Peck, in Bull. Torr. Bot. Cl., ix., p. 61 (1882). Sporangia stipitate, shortly cylindrical, perforated by a deep umbilicus. Capillitium of delicate parallel threads with minute fusiform lime-knots and stout spine-like processes projecting perpendicularly from the sporangium-wall.

1. **P. mirabilis** Peck, *l.c.* Plasmodium rich yellow. Total height 3 mm. Sporangia shortly cylindrical, inclined, 0·8 mm. long, 0·6 mm. broad, gregarious, stipitate, perforated by a deep umbilicus, which is continuous with the hollow stem, greenish or reddish-yellow. Sporangium-wall thickened with innate deposits of yellow lime-granules and studded with the bases of the spine-like processes of the capillitium, at length dehiscing round the margin of the cylinder, and recurving in stellate lobes from the wall of the umbilicus, which persists to form a hollow pseudo-columella. Stalk cylindrical, slender, broader at the base, striate,

red-brown. Capillitium of abundant filiform forking pale yellow threads, with few minute fusiform yellow lime-knots, and yellow spine-like processes 2 mm. long, 20 μ thick, extending from the outer wall of the sporangium to the walls of the pseudo-columella, densely charged with granules of lime. Spores violet-brown, nearly smooth, 6 to 8 μ diam.—Macbride, Bull. Nat. Hist. Iowa, ii., p. 151. *Trichamphora oblonga* Berk. & Curt., in Grev., ii., p. 66 (1873). *Tilmadoche oblonga* Rost., Mon., App., p. 13; Mass., Mon., p. 334. *Physarum rufibasis* Berk & Br., in Linn. Journ., xiv., p. 85; Mass., Mon., p. 279. *Tilmadoche hians* Rost., Mon., App., p. 14. *Physarum hians* Mass., Mon., p. 296 (in part). *Tilmadoche minuta* Berl., Sacc. Syll., vii., p. 361.

Plate XXV., B.—*a.* sporangia, × 20; *b.* transverse section of same, × 20; *c.* sporangium after dehiscence and dispersion of spores, × 20; *d.* capillitium, and calcareous spines arising from the sporangium-wall, × 280; *e.* spore, × 600 (United States).

The examination of Berkeley's type specimens of *Physarum rufibasis* Berk. & Br. from Ceylon, and *Trichamphora oblonga* Berk. & Curt. from Michener, Pennsylvania, U.S.A., shows that they are the same species, and possess the same characters of sporangium and capillitium as *Physarella mirabilis* — characters so remarkable that the species well deserves to rank as the type of a distinct genus. Forms occur in imperfect developments with short broad stalks and funnel-shaped sporangia, examples of which are seen in Berkeley's type specimen of *Physarum rufibasis*, as well as in American specimens. *Tilmadoche hians* is described by Rostafinski as having the tube of the stalk hollow and completely traversing the oblong sporangium, and the lime-knots of the capillitium irregularly elongated, taking origin for the most part from the sporangium-wall. He quotes two gatherings only: one, the above-mentioned *P. rufibasis* Berk. & Br., from Ceylon; the other referred to as follows: "The specimen seen was gathered by Jan Kickx (father) in Flanders, and marked by him *Craterium minutum* Fr." (Rost., Mon., p. 425.)

Hab. On dead wood. — Ceylon (L:B.M.44); Java (K. 1312); Borneo (L:B.M.44); Pennsylvania (B. M. 852, 882).

Genus 7.—**CRATERIUM** Trentepohl, in Roth. Catal. Bot., i., p. 224 (1797). Sporangia stipitate, goblet-shaped, with a lid of thinner substance, or subglobose, rugose; sporangium-wall charged with granules of lime, and cartilaginous at least in the lower part. Capillitium of large lime-knots connected by more or less branching hyaline threads. In the centre of the sporangium the lime-knots are usually larger and confluent, forming a pseudo-columella. Stalk cartilaginous.

KEY TO THE SPECIES OF *CRATERIUM*.

A. Sporangium-wall smooth, glossy:—

Lime-knots white.	1. *C. pedunculatum*
Lime-knots brown.	2. *C. concinnum*

B. Sporangium-wall mealy or rugose :—

Sporangia violet. 3. *C. rubescens*

Sporangia brown, powdered with white on the upper part. 4. *C. leucocephalum*

Sporangia yellow :—

Sporangia ovoid ; spores 7 to 9 μ. 5. *C. mutabile*

Sporangia globose ; spores 10 to 12 μ. 6. *C. citrinellum*

1. **C. pedunculatum** Trentepohl, in Roth, Catal. Bot., i., p. 224 (1797). Plasmodium rich yellow, amongst dead leaves. Total height 0·7 to 1·5 mm. Sporangia goblet-shaped, stipitate, erect, gregarious, 0·4 to 1·2 mm. high, smooth, pale ochraceous, nut-brown or olive-brown; lid either convex, flat, or depressed below the rim, white or concolorous with the sporangium. Sporangium-wall of two or three layers, the outer cartilaginous, thickened at the rim, translucent below and continued into the translucent stalk, the inner layer densely charged with white lime-granules; lime almost absent in the olive-brown form. Stalk equal, plicate, 0·3 to 0·5 mm. long, varying from dark brown to yellowish, usually darker than the sporangium, rising from a circular hypothallus. Columella represented by a central mass of confluent lime-knots, not always present. Capillitium of large white lime-knots connected by delicate colourless or yellow threads. Spores clear violet-brown, minutely warted, 8 to 9 μ diam.—Macbride, in Bull. Nat. Hist. Iowa, ii., p. 385. *Craterium vulgare* Ditm., in Sturm, Deutsch. Fl., Pilze, i., p. 17, t. 9 (1813); Rost., Mon., p. 118, figs. 94, 96; Cooke, Myx. Brit., p. 18. *C. pyriforme* Ditm., *l.c.*, p. 19, t. 10; Rost., Mon., p. 120; Cooke, Myx. Brit., p. 19. *Peziza minuta* Leers, Fl. Herbo., p. 277 (1775). *C. minutum* Fr., Syst. Myc., iii., p. 151; Rost., Mon., p. 120; Cooke, Myx., p. 19. *C. Œrstedtii* Rost., Mon., p. 120, fig. 99; Mass., Mon., p. 266. *C. Friesii* Rost., Mon., p. 122, fig. 105. *C. confusum* Mass., Mon., p. 263.

Plate XXVI., A.—*a.* sporangia of various forms, × 20; *b.* capillitium and spores, × 280; *c.* spore, × 600 (England).

Observations of the development of sporangia from extensive plasmodia in leaf-heaps and in cultivations show that the varieties in shape and colour described by Rostafinski under the names of *C. vulgare*, *C. pyriforme*, *C. minutum*, and *C. Friesii* may arise from one source, and no specific characters appear to exist to separate the four forms. In examination of the type specimen of *C. Œrstedtii* in the Strassburg Herbarium no character was observed to distinguish it from *C. pedunculatum* ; the sporangia are pyriform, and yellow brown ; no lid remains attached to a sporangium, but it is described as white ; the capillitium resembles that met with in most forms of *C. pedunculatum ;* a distinct pseudo-columella is present. The specimens from America are mostly of the type in the Strassburg collection named *C. vulgare* var. *verum* (or *genuinum*). They are of a dark olive colour, somewhat small in size, and without a pseudo-columella. The most frequent form in Europe appears to be the var. *confusum* in the Strassburg Herb. ; it is broader in shape, and yellow-brown. When exposed to

weather the sporangia often lose their colour and become white. *Diderma brunneolum* Phill., from California, Harkness, is allied to this species in the smooth yellow-brown cartilaginous outer sporangium-wall enclosing a densely calcareous inner layer, and in the character of the capillitium. It differs in the sporangia being globose and sessile, in the outer wall being continuous throughout, without a lid of different substance, and in the greater roughness of the spores. It appears to be a single gathering, and if a constant form may constitute a distinct species.

Hab. On dead leaves, sticks, etc.—Lyme Regis, Dorset (L:B.M.45); Batheaston, Somerset (B. M. 179 to 183); Raincliffe Wood, Yorkshire (B. M. 1057); France (B. M. 469); Germany (B. M. 473); Italy (K. 257); Sweden (K. 1359); Hungary (K. 1362); Ceylon (B. M. 472); New Zealand (K. 254); Pennsylvania (L:B.M.45); Iowa (L:B.M.45).

2. **C. concinnum** Rex, in Proc. Acad. Nat. Sc. Phil. 1893, p. 370. Plasmodium ? Total height 0·5 to 0·7 mm. Sporangia broadly funnel-shaped or goblet-shaped, stipitate, 0·2 to 0·5 mm. diam., smooth, olive-brown, often paler above, dehiscing by a well-defined convex white lid; sporangium-wall cartilaginous. Stalk brown, 0·1 to 0·2 mm. long, plicate. Columella none. Capillitium of numerous small angular lime-knots, connected by short and sparingly branched hyaline threads. Spores purplish-brown, minutely warted, 8 to 9 μ diam.

Plate XXVI., B.—*a*. sporangia, × 20; *b*. capillitium and spores, with fragment of sporangium-wall, × 280; *d*. spore, × 600 (United States).

This species is nearly allied to the American form of *C. vulgare*, but differs in the smaller size, the brown lime-knots, and the browner spores; it appears to have been found almost exclusively on the burs of chestnut in Fairmount Park, Philadelphia.

Hab. Philadelphia (L:B.M.46).

3. **C. rubescens** Rex, in Proc. Acad. Nat. Sc. Phil. 1893, p. 370. Plasmodium ? Sporangium goblet-shaped, stipitate, erect, gregarious, 0·7 to 0·8 mm. high, 0·6 mm. broad, rugose, bright violet, irregularly reticulate with pale violet. Lid convex. Sporangium wall cartilaginous, composed of two or three closely connected layers with deposits of pale violet lime-granules, distributed throughout, but chiefly concentrated in pouch-like cavities of the wall, causing the effect of pale reticulations in the opaque object. Columella represented by a central mass of confluent lime-knots. Stalk cylindrical, 0·4 mm. high, 0·07 mm. thick, plicate, purple, opaque, arising from a disc-shaped hypothallus. Capillitium of large violet lime-knots, connected by branching pale violet hyaline threads. Spores violet, nearly smooth, 8 to 9 μ diam.—*Didymium paraguayense* Speg., in Anal. Soc. Cient. Argent., xxii., p. 186, No. 320 (1886). Mass., Mon., p. 250. *D. guarapiense* (errore) Speg., *l.c.*, xxvi., p. 60, No. 154. *Physarum pulcherrimum* Mass., Mon., p. 293 (in part).

Plate XXVII., A.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (Paraguay).

The specimen from Paraguay named *Didymium paraguayense* Speg. (B.M. 1002) has rather larger sporangia, and these with the capillitium and spores are of a brighter colour than the type from Louisiana, but in other respects they are identical. This species is closely allied to *Physarum Newtoni* Macbr.

Hab. On leaves.—Louisiana U.S.A. (L:B.M. 47) ; Paraguay (B. M. 1002.)

4. **C. leucocephalum** Ditm., in Sturm, Deutsch. Fl., Pilze, p. 21, t. 11 (1813). Plasmodium rich yellow, among dead leaves. Total height 1 mm. Sporangia ovoid or turbinate, stipitate, erect, 0·7 mm. high, 0·5 mm. broad, red-brown with white incrustations of lime and scattered yellow warts on the upper half. Lid white, convex, continuous with the wall of the cup. Sporangium-wall thin, consisting of two closely connected layers, the outer yellow, the upper part provided with scattered lime-deposits and beset with shallow, often colourless pits, containing dense aggregations of white lime-granules, usually in company with yellow crystalline disc-shaped bodies ; the lower part cartilaginous, translucent, of deeper colour, and continued into the translucent stalk ; the inner layer membranous and colourless. Stalk equal, plicate, 0·3 to 0·5 mm. long, red-brown, cartilaginous, rising from a circular hypothallus. Columella represented by a central mass of confluent lime-knots. Capillitium of large, irregularly shaped, white or yellowish lime-knots, connected by yellow, branching, hyaline threads, with frequent flattened expansions at the axils. Spores violet-brown, spinulose, 7 to 9 μ diam.—Rost., Mon., p. 123 ; Cooke, Myx. Brit., p. 19 ; Mass., Mon., p. 267 ; Blytt, Bidr. Norg., Sop. iii., p. 5 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 154. *Stemonitis leucocephala* Pers., in Gmel., Syst. Nat., p. 1467 (1791). *Physarum scyphoides* Cooke & Balf., in Rav., Fungi Amer., 480 ; Mass., Journ. Myc., v., p. 186, Pl. xiv., fig. 7 ; Mass., Mon., p. 282. *Craterium pruinosum* Corda, Ic., v., p. 13, t. ii., f. 33. *C. minimum* Berk. & Curt., in Grev., ii., p. 67 ; Mass., Mon., p. 272. *C. Fuckelii* Mass., Mon., p. 272. *C. cylindricum* Mass., Mon., p. 268.

Plate XXVII., B.—*a.* to *e.* sporangia of various forms, × 20 ; *f.* capillitium, with pseudo-columella, × 35 ; *g.* sporangium-wall, showing crystalline bodies, and spores, × 280 ; *h.* spore, × 600 (England) ; *i.* cylindrical sporangium, × 20 (United States) ; *k.* sporangium, from type of *Physarum scyphoides*, Cooke & Balf., × 20 ; *l.* vertical view of half-empty sporangium from the same gathering, showing pseudo-columella, × 20 (Georgia, U.S.A.).

The yellow crystalline bodies are a marked feature in this species. They are frequently absent from the sporangium-wall, but can be detected in the large lime-knots and in the columella by treating with hydrochloric acid, when they remain after the lime-granules are dissolved. In the delicate cylindrical sporangia, in which the double layer of the wall can scarcely be distinguished, they are to be found only in the columella, and are sometimes entirely wanting. Those in the wall are either nearly superficial and can easily be detached, or are embedded in its substance ; they are usually disc-shaped, measuring 15 to 40 μ diam., with a crenate margin, and marked with lines radiating

from the centre to the circumference. Those in the lime-knots are somewhat globular, and are often in clusters ; they vary from 5 μ to about 20 μ diam., and dissolve rapidly in dilute carbolic acid. (Noted in the Kew coll., 1888.—A. L.) *Physarum scyphoides* Cke. & Balf. appears to be a form of *C. leucocephalum* ; the sporangium-wall (× 560) is veined with yellow, and possesses the colourless pits charged with lime-granules of the type, from which it only differs in the more delicate wall in the upper part, and in the somewhat obovoid shape of some of the sporangia. *C. cylindricum* Mass. is a form of *C. leucocephalum* with cylindrical sporangia ; and in no other character does it differ from the broader type, with which it is connected by intermediate links. The specimen issued by Fuckel as *C. mutabile* Fr., 1455 Fung. Rhen. Exs. (B. M. 481, K. 300), (*C. Fuckelii* Mass.), is a subglobose form of *C. leucocephalum* with the lime in the sporangium-wall almost absent ; the spores measure 9 to 10 μ diam., and are minutely spinulose. *C. minimum* Berk. & Curt. is represented in Ravenel's collection, B. M. 873, "fide Berkeley." It is the cylindrical form of *C. leucocephalum* ; the sporangia are rufous below, white and pruinose in the upper part ; the capillitium shows a pseudo-columella, and the spores are typical.

Hab. On dead leaves.—Wanstead, Essex (L:B.M.48) ; Luton, Beds. (L:B.M.48) ; France (K. 282) ; Germany (B. M. 471) ; Austria (B. M. 1058) ; Sweden (K. 298) ; Italy (K. 297) ; Java (Strassb. Herb.) ; Pennsylvania (L:B.M.48) ; Ohio (L:B.M.48) ; Georgia (B. M. 455) ; Brazil (K. 274).

5. **C. mutabile** Fries, Syst. Myc., iii., p. 154 (1829), non Symb. Gast. Plasmodium lemon-yellow, among dead leaves. Total height 0·7 to 1 mm. Sporangia ovoid or globose, 0·4 to 0·6 mm. diam., stipitate, erect, gregarious, rugose, without a defined lid, golden yellow or greenish, bright yellow on the summit, breaking up at maturity in the upper part into areolæ, or dehiscing almost to the base in stellate lobes ; sporangium-wall single, membranous, with deposits of innate yellow lime-granules, which are denser and of a deeper yellow on the summit, somewhat stouter and more persistent at the base, where it is continued into the cartilaginous stalk. Columella represented by a central mass of confluent lime-knots, not always present. Stalk cylindrical, 0·2 to 0·5 mm. long, stout, deeply furrowed, nearly translucent, but charged with lime-granules, orange-red or yellow, arising from a circular hypothallus. Capillitium of irregularly shaped yellow lime-knots, varying much in size, connected by a network of hyaline threads with triangular expansions at the axils of the branches. Spores violet-brown, spinulose, 8 to 9 μ diam.—Wallr., Fl. Crypt. Germ., ii., p. 357. *Trichia aurea* Schum., En. Pl. Saell., ii., p. 207 (1803). *Craterium aureum* Rost., Mon., p. 124 (1875) ; Cooke, Myx. Brit., p. 20 ; Mass., Mon., p. 269.

Plate XXVIII., A.—*a.* to *d.* sporangia of various forms, × 20 ; *e.* capillitium and spores, with fragment of sporangium-wall, × 280 ; *f.* spore, × 600 (England).

Hab. On dead leaves, etc.—Lyme Regis, Dorset (L:B.M.49) ; Luton, Beds. (L:B.M.49) ; Batheaston, Somerset (B. M. 133) ; Appin,

Scotland (K. 299); France (Paris Herb.); Germany (Strassb. Herb.); Ohio (L:B.M.49); S. Carolina (B. M. 888).

6. **C. citrinellum** Lister. Plasmodium? Sporangia subglobose, 0·6 to 0·8 mm. diam., stipitate, erect, gregarious, rugose, lemon-yellow or ochraceous, tinged with orange at the base; sporangium-wall of two layers, the outer cartilaginous, yellow, rugose from dense innate areolated deposits of lime, easily separating from the colourless membranous inner layer. Columella none. Stalk cylindrical, 0·3 to 0·4 mm. high, stout, plicate, orange-red, translucent. Capillitium a network of colourless hyaline threads, with many large, irregular, and branching white lime-knots. Spores purple-brown, rather strongly spinulose, 10 to 12 μ diam. —*Diderma citrinum* Peck, in Rep. N. York Mus. Nat. Hist., xxii., p. 89 (1869). *Physarum citrinellum* Peck, *l.c.*, xxxi., p. 55 (1879); Mass., Mon., p. 278.

Plate XXVIII., B.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (United States).

Closely allied to *Craterium mutabile* Fries, from which it differs in the stouter structure of the sporangium-wall and in the larger, rougher spores. The type specimen of *Physarum lepidodermoides* Blytt, Bidr. Norg., Sop. iii., p. 4 (1892), from Rollag, Telemarken, on moss, has subglobose stipitate sporangia, 0·7 to 0·8 mm. diam.; the sporangium-wall breaks up into shining convex pale brown scales, densely charged with deposits of lime; there is no columella; the stalks are 0·5 mm. high, stout, broader at the base, pale yellow-brown, without lime-deposits; the capillitium consists of large irregular pale brown lime-knots connected by branching hyaline threads; the spores are purple-brown, spinulose, 9 to 11 μ diam. This appears to be represented by a single gathering, and to have close affinity with *C. citrinellum*.

Hab. On moss.—New York (L:B.M.50). Allied species; *Physarum lepidodermoides*, Norway (L:B.M.50).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

7. **C. porphyrium** Schwein., in Trans. Am. Philos. Soc., Phil. iv., p. 258; sporangia densely clustered, turbinate, purple-red, glossy; stalks very short, connate into a thick basal mass; spores and the elastically expanding capillitium red.

This description applies to *Hemitrichia rubiformis* List.

SPECIES EXCLUDED FROM THE GENUS.

C. rubiginosum Mass. = *Badhamia rubiginosa* Rost.
C. dictyospermum Mass. = *Badhamia rubiginosa* Rost.
C. Curtisii Mass. = *Badhamia rubiginosa* Rost.
C. lilacinum Mass. = *Badhamia lilacina* Rost.

Genus 8.—**LEOCARPUS** Link, in Berl. Ges. Nat. Fr. Mag., iii., p. 25 (1809). Sporangium with two walls, the outer cartilaginous and calcareous, shining; the inner hyaline. Capillitium more or less arranged in two systems, one consisting of a network of rigid hyaline threads, the other of coarse anastomosing branches charged with coloured granules of lime.

1. **L. vernicosus** Link, *l.c.* (1809). Plasmodium orange-yellow, among dead leaves. Sporangia obovoid or globose, sessile or shortly stalked, crowded, 2 to 4 mm. long, chestnut or purple-brown, shining as if varnished, sometimes dehiscing in revolute floriform lobes; sporangium-wall double: the outer wall consisting of two layers, the outer cartilaginous, orange-brown, the inner densely calcareous, white; the inner wall is hyaline, giving attachment to the capillitium. Columella none. Stalk short, weak, yellowish, translucent, arising from a membranous hypothallus. Capillitium a network of rigid hyaline threads with flattened expansions at the axils and with few lime-knots, connected with a system of coarse branches often combined into a dense network and charged throughout with brownish lime-granules. Spores violet-brown, spinulose, 11 to 13 μ diam., occasionally 15 to 20 μ diam., rarely clustered as in Badhamia.—Grev., Scot. Crypt. Fl., ii. (1824), t. 111. *Diderma vernicosum* Pers.. in Usteri, Ann. Bot., xv., p. 34 (1795). *Lycoperdon fragile* Dicks., Pl. Crypt. Brit., i., p. 25 (1785). *Leocarpus fragilis* Rost., Mon., p. 132, fig. 93; Cooke, Myx. Brit., p. 23; Mass., Mon., p. 338; Blytt, Bidr. Norg., Sop. iii., p. 5; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 153.

Plate XXIX., A.—*a.* sporangia, × 20; *b.* capillitium and spores with fragment of sporangium-wall showing the three layers, × 170; *c.* spore, × 600 (England).

Hab. On dead leaves, etc.—Hornsey, Middlesex (B. M. 22); Epping Forest, Essex (L:B.M.51); Leighton Buzzard, Beds. (L:B.M.51); Lyme Regis, Dorset (L:B.M.51); Mortonhall, Edinburgh (B. M. 1061); France (Paris Herb.); Belgium (B. M. 482); Germany (B. M. 1059); Poland (Strassb. Herb.); Bohemia (B. M. 489); Finland (B. M. 492); Tasmania (K. 1390); Mass., U.S.A. (B. M. 493); Iowa (B. M. 818); S. Carolina (B. M. 495).

Leocarpus ramosus Fr. Summ. Veg. Scan., p. 450, is excluded by Rostafinski, on the ground of its being probably an immature specimen of *L. vernicosus* (Rost., Mon., p. 306).

Genus 9.—**CHONDRIODERMA** Rostafinski, Versuch, p. 13 (1873). Sporangia sessile or stipitate; sporangium-wall of two layers, the outer either a crust composed of globular lime-granules and usually separating from an inner membranous layer, or cartilaginous, more or less charged with lime, and not separating from the inner layer (except in *C. Sauteri*); capillitium without lime-knots. The genus *Chondrioderma* embraces two sub-genera, *Euchondrioderma* and *Leangium*, which are connected by intermediate forms.

KEY TO THE SPECIES OF *CHONDRIODERMA*.

A. Sporangium-wall densely calcareous (*Euchondrioderma*) :—
- A. Spores reticulated. 2. *C. subdictyospermum*
- B. Spores not reticulated—
  - *a*. Columella white or pinkish, sporangia white.
    Spores violet-brown, 7 to 11 μ diam. 1. *C. spumarioides*
    Spores dark purplish-brown, 10 to 14 μ diam. 3. *C. globosum*
  - *b*. Columella flesh-coloured, hemispherical or flattened.
    Sporangia subglobose, sessile, pink— 4. *C. testaceum*
    Sporangia disc-shaped, stalked, columella flattened. 5. *C. Michelii*
    Sporangia forming plasmodiocarps, white. 6. *C. reticulatum*
  - *c*. Columella orange, hemispherical, or hardly evident. 7. *C. niveum*
  - *d*. Columella red-brown, clavate or cylindrical. 8. *C. Lyallii*

B. Sporangium-wall cartilaginous (*Leangium*) :—
- A. Sporangium-wall white and crystalline on the inner side. 9. *C. Trevelyani*
- B. Sporangium-wall without a crystalline layer—
  - *a*. Spores with widely scattered warts. 13. *C. floriforme*
  - *b*. Spores closely spinulose, warted, or nearly smooth—
    Columella hardly evident, sporangia sessile. 10. *C. Sauteri*
    Columella hemispherical or subglobose; stalk stout, ochraceous. 11. *C. radiatum*
    Columella clavate, white; stalk slender, black. 12. *C. rugosum*
    Columella cylindrical, brown; stalk dark brown. 14. *C. Hookeri*
    Columella stipitate, brown; stalk orange. 15. *C. lucidum*

Sub-genus 1.—**Euchondrioderma**. Sporangia sessile, rarely stipitate; sporangium-wall double, the outer layer a smooth crust composed of globular lime-granules, the inner membranous, more or less separating from the outer layer.

1. **C. spumarioides** Rost., Mon., p. 174, figs. 142 to 145, 151 (1875). Plasmodium white, among dead leaves. Sporangia sub-

globose, sessile, crowded, 0·5 to 1 mm. diam., seated usually on a strongly developed white hypothallus, smooth or rugose, white; sporangium-wall of two layers, the outer thick, fragile, composed of globular lime-granules 1 to 2 μ diam., often crumbling away from the membranous, more persistent inner layer, sometimes inseparable. Columella convex or hemispherical, white or pale flesh-coloured. Capillitium of slender, flexuose, purplish threads, branching at an acute angle and somewhat anastomosing. Spores violet-brown, spinulose, 8 to 11 μ diam.—Cooke, Myx. Brit., p. 38. *Didymium spumarioides* Fr., Symb. Gast., p. 20 (1818); Mass., Mon., p. 232. *Physarum stromateum* Link, Handb., iii., p. 409 (1833). *Chondrioderma stromateum* Rost., Mon., App., p. 18. *Chondrioderma virgineum* Mass., Mon., p. 207.

Plate XXIX., B.—*a.* sporangia, × 20; *b.* capillitium, with fragment of sporangium-wall and spores, × 280; *c.* spore, × 600 (England).

The type specimen of *C. virgineum* Mass. (K. 560) is a frequent form of *C. spumarioides* without hypothallus; the capillitium in some sporangia is normal and without expansions. The type specimen of *C. stromateum* Rost. in the Strassb. Herb. is from Lochem (leg. Spree, Rab. Fung. Eur., 432); a part of this gathering is in the British Museum (B. M. 515); it does not appear to present any character by which it can be separated from *C. spumarioides*.

Hab. On dead leaves, etc. Common.—Lyme Regis, Dorset (L:B.M.52); France (K. 37); Germany (B. M. 515); New York (B. M. 886); Mass., U.S.A. (L:B.M.52).

2. **C. subdictyospermum** Rost., Mon., App., p. 16 (1876). Plasmodium? Sporangia subglobose, sessile, crowded, 0·3 to 0·5 mm. diam., snow-white, seated on a well-developed white hypothallus; sporangium-wall thick, fragile, composed of an outer crust of globular lime-granules 2 μ diam., with a delicate, membranous, inseparable inner layer. Columella hemispherical or subglobose, white. Capillitium of somewhat rigid, violet-brown, sparingly branched threads. Spores violet-brown, reticulated with raised ridges or with broken bands, forming a margin about 2 μ broad; 10 to 12 μ diam.—*Didymium dealbatum* Berk. & Curt., in Herb. *Chondrioderma dealbata* Mass., Mon., p. 207.

Plate XXX., B.—*d.* sporangia, × 20; *e.* capillitium and spores, × 280; *f.* spore, × 600 (Venezuela, Rostafinski's type); *g.* spore, × 600 (Cape).

This species appears to be allied to *C. spumarioides*, differing essentially in the spores. It is represented by two gatherings. One is from Venezuela, named *Didymium dealbatum* Berk. & Curt. (B. M. 570; K. 1522); this is the type given by Rostafinski (Mon., App., p. 16), and accurately described as having spores provided with protuberances either irregularly disposed or combined into an incomplete net. The other gathering is in the Kew collection (K. 466), named *Didymium physaroides*, Cape 198; in this specimen the spores are more perfectly reticulated, and, except in colour, resemble those of *Trichia favoginea* Pers.; the capillitium is also more flexuose.

Hab. On moss.—Cape (K. 466); Venezuela (B. M. 570).

3. **C. globosum** Rost., Mon., p. 180, fig. 138 (1875). Plasmodium white, among dead leaves. Sporangia globose, sessile, crowded, 0·5 to 0·8 mm. diam., seated on a strongly developed white or cream-coloured hypothallus, smooth, white or cream-coloured; sporangium-wall of two layers, the outer composed of globular lime-granules 1 to 2 μ diam., separating widely from the membranous inner layer. Columella hemispherical or subglobose, often minute, white or pale flesh-coloured. Capillitium of slender, irregularly branched, and anastomosing pale purplish threads. Spores dark purplish-brown, spinulose, 10 to 14 μ diam.—Cooke, Myx. Brit., p. 39; Mass.,,Mon., p. 206; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 147. *Diderma globosum* Pers., in Röm., N. Mag. Bot., i., p. 89 (1794). *Chondrioderma affine* Rost., Mon., App., p. 18; Mass., Mon., p. 210. *C. simulans* Rost., Mon., App., p. 20; Mass., Mon., p. 209. *Diderma crustaceum* Peck, in Rep. N. York Mus. Nat. Hist., xxvi., p. 74. *Chondrioderma crustaceum* Berlese, in Sacc., Syll., vol. vii., p. 373; Mass., Mon., p. 215.

Plate XXX., A.—*a*. sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (Poland, Rostafinski's type).

The capillitium of this species often encloses particles of lime in expansions towards the base of the threads. *C. globosum* is closely allied to *C. spumarioides*, differing chiefly in the large and dark spores. Rostafinski's type specimen of *C. globosum* from near Warsaw, in Strassb. Herb., has dark spinulose spores 11 to 13 μ diam.; his type specimen of *C. affine* Rost. from near Warsaw is the same form. *C. simulans* Rost. is described as differing chiefly from *C. globosum* in the rough spores, 12·5 μ diam.; as the spores of the type specimen of *C. globosum* correspond with this definition, *C. simulans* cannot be considered a separate species.

Hab. On dead leaves, etc.—France (Paris); Strassburg (L:B.M.54); Poland (Strassb. Herb.); Italy (B. M. 525); Iowa (B. M. 816).

4. **C. testaceum** Rost., Versuch, p. 13 (1873). Plasmodium? Sporangia sessile, subglobose, depressed on a broad base, sometimes confluent, 0·8 mm. diam., smooth, dull flesh-coloured or pale pinkish, often becoming bleached; sporangium-wall of two layers, the outer thin, brittle, egg-shell-like, composed of globular lime-granules, separating freely from the more persistent, pinkish-grey, membranous inner layer. Columella large, convex or hemispherical, together with the base of the sporangium flesh-coloured or reddish-brown. Capillitium of delicate, faintly purplish, branching flexuose threads. Spores pale violet-brown, almost smooth, 7 to 8 μ diam.—Rost., Mon., p. 179, figs. 135, 136; Mass., Mon., p. 210; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 148. *Didymium testaceum* Schrad., Nov. Pl. Gen., p. 25 (1797). *Diderma testaceum* Pers., Syn., p. 167. *Diderma sublateritium* Berk. & Br., in Journ. Linn., xiv., p. 82. *Chondrioderma sublateritium* Rost., Mon., App., p. 19; Mass., Mon., p. 211. *Diderma Cubense* Berk. & Curt., in Journ. Linn., x., p. 347.

Chondrioderma Cubense Rost., Mon., App., p. 19. *Chondrioderma difforme* Mass., Mon., p. 213 (in part). *Diderma Mariæ-Wilsoni* Peck, in Rep. N. York Mus. Nat. Hist., xxvi., p. 74.

Plate XXX., B.—*a*. Sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall, and spores, × 280; *c*. spore, × 600 (Poland, Rostafinski's type).

The type specimen of *Diderma sublateritium* Berk. & Br., from Ceylon (K. 1454), is more rufous in colour than is usual in *C. testaceum*, though not so deep in tone as the specimen from S. Carolina (B. M. 520); the capillitium and spores are typical of this species, of which it is clearly a form.

Hab. On dead leaves.—Flitwick, Beds. (L:B.M.55); Moffat, Scotland (L:B.M.55); France (B. M. 517); Germany (B. M. 516); Poland (Strassb. Herb.); Ceylon (L:B.M.55); New York (L:B.M.55); Ohio (L:B.M.55); S. Carolina (B. M. 520); Cuba (L:B.M.55).

5. **C. Michelii** Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 74 (1873). Plasmodium opaque white. Sporangia flat, disc-shaped on a central stalk, rarely sessile on a broad base and confluent, chalk-white, 1 to 1·25 mm. wide; sporangium-wall of two layers on the flat upper surface, the outer a fragile smooth crust composed of globular lime-granules 1 to 3 μ diam., separating from the more persistent membranous inner layer; under surface rugose. Stalk pale ochraceous, 0·5 mm. long, 0·25 mm. thick, furrowed with wrinkles, which are continued over the flat under side of the sporangium; densely calcareous. Columella indefinite, consisting of the broad thickened base of the sporangium, flesh-red or flesh-brown, charged with calcareous deposits in the form of nodules and large rhomboidal granules. Capillitium of colourless delicate threads, variously branched and anastomosing, or of violet-brown threads 1 to 2 μ thick, sparingly branched except at the pale extremities. Spores pale violet-brown, almost smooth, 7 to 9 μ diam.—Mon., p. 172, figs. 131, 146, 149, 150. Cooke, Myx. Brit., p. 37; Mass., Mon., p. 204. *Didymium Michelii* Lib., Pl. Ardu. Exsic., Fasc. ii., No. 180. *Physarum depressum* Schum., Enum. Pl. Saell., ii., p. 202 (1803). *Diderma depressum* Fr., Syst. Myc., iii., p. 108 (?).

Plate XXXI., A.—*a*. sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall and spores, × 280; *c*. capillitium, with stouter and more rigid threads, × 280; *d*. rhomboidal nodules of lime from stalk, × 280; *e*. spore, × 600 (England).

Hab. On dead leaves, etc. Common. — Lyme Regis, Dorset (L:B.M.56); Batheaston, Somerset (B. M. 47); Boynton, Yorkshire (B. M. 1112); France (Paris Herb.); Belgium (B. M. 513); Germany (Strassb. Herb.); Sweden (K. 1449); Ceylon (K. 1440); S. Carolina (B. M. 890); Pennsylvania (L:B.M.56).

6. **C. reticulatum** Rost., Mon., p. 170 (1875). Plasmodium ? Sporangia rounded, much depressed, sessile, gregarious, 0·7 mm. diam., or more usually elongated and forming flat branching or net-like plasmodiocarps, smooth, white; sporangium-wall of two layers, the outer a fragile crust of globular lime-granules, separating

from the membranous colourless inner wall. Columella convex or depressed, brownish flesh-coloured, enclosing white lime-granules. Capillitium of delicate colourless or pale purplish threads, sparingly branched and anastomosing. Spores pale violet-brown, nearly smooth, 6 to 8 μ diam.—Mass., Mon., p. 216. *Didymium reticulatum* Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 73 (1873). *Chondrioderma Saundersii* Berk. & Br., in Mass., Mon., p. 209.

Plate XXXI., A.—*f.* orbicular and plasmodiocarp sporangia, × 20 (United States).

Rostafinski's type specimen at Strassburg consists of flattened, white, branching or net-like plasmodiocarps, with capillitium and spores as described above. It is a question whether this species should not be placed as a variety of *C. Michelii*, from which it differs only in the shape of the sporangia. Instances have occurred in which the stalked and plasmodiocarp forms have been found together, with strong evidence that they sprung from the same plasmodium. On the other hand, they are so constant that, for convenience, the name given by Rostafinski is retained in this catalogue for the sessile and plasmodiocarp forms. From plasmodiocarp forms of *C. testaceum* it is distinguished by the flat sporangia and the absence of any rosy tinge in the sporangium-wall and columella. The Ceylon gatherings, marked "75. *Diderma depressum* Fr." (B. M. 514 ; K. 1438, 1439), show flattened white plasmodiocarps, with brownish flesh-coloured columella, and must be referred to *C. reticulatum* ; as also must *C. Saundersii* Berk. & Br., from Java (K. 1479), in the type specimen of which the broad, extensive plasmodiocarps resemble the American gatherings.

Hab. On dead leaves, sticks, etc.—Luton, Beds. (L:B.M.57) ; Switzerland (Strassb. Herb.) ; Ceylon (B. M. 514) ; Java (K. 1479) ; Ohio (L:B.M.57) ; Philadelphia (L:B.M.57) ; Iowa (B. M. 1022).

7. **C. niveum** Rost., Mon., p. 170 (1875). Plasmodium ? Sporangia subglobose, depressed, sessile, crowded, 0·7 to 1·5 mm. diam., or forming scattered plasmodiocarps, sometimes seated on a white or dull yellow hypothallus, smooth, chalk-white ; sporangium-wall of two layers, the outer densely charged with white lime-granules, separating from the inner layer, which is orange, membranous above, cartilaginous below. Columella broad, convex, together with the base of the sporangium, orange. Capillitium of purple threads, sparingly branched except at the pale extremities, rigid, sometimes intermixed with more delicate threads, more or less closely beset with wart-like thickenings. Spores violet-brown, minutely spinulose, 9 to 11 μ diam.—Rost., Mon., App., p. 16 ; Cooke, Myx. Brit., p. 37 ; Blytt, Bidr. Norg., Sop. iii. (1892), p. 6. *Diderma albescens* Phill., in Grev., v., p. 114. *Chondrioderma albescens* Mass., Mon., p. 209. *Diderma deplanatum* Fr., Syst. Myc., iii., p. 110 ; Berk., in Engl. Fl., v., part ii., p. 312. *Chondrioderma deplanatum* Rost., Mon., App., p. 17 (in part) (1876).

a. **genuinum** : sporangia subglobose, crowded.

β. **deplanatum** : sporangia forming plasmodiocarps, scattered.

Plate XXXI., B.—*a.* sporangia, × 20 ; *b.* capillitium and spores, × 280 ; *c.* spore, × 600 (Vosges Mts. ; Rostafinski's type) ; *d.* sporangia of form

connecting *a. genuinum* with *β. deplanatum*, × 2 ; *e.* plasmodiocarp of the same gathering, × 20 (Chiselhurst, England, B. M. 27).

Rostafinski's type specimen of *C. niveum* in Strassb. Herb., from Giromagny, has subglobose, crowded sporangia, with a fragile, egg-shell-like outer wall ; the inner wall is membranous, more persistent, orange at the base ; the columella is orange, sometimes scarcely developed ; the capillitium threads are rigid and warted. The specimen in Berkeley's collection from Linlithgow, named by him *Diderma cyanascens* Fr. and by Rostafinski *C. niveum* (K. 1435), is a plasmodiocarp form, with the lower part of the inner wall and base orange, and the columella depressed ; it has the same rigid warted threads as in the Strassburg type. There is no type specimen from Fries of *Diderma deplanatum* in the Strassburg or British collections, but his description (Syst. Myc., iii., p. 110) applies well to Berkeley's specimen named *D. deplanatum* Fr. from Appin (K. 410), which is accurately described in *English Flora* (*l.c.*), and is undoubtedly the same species as the Linlithgow specimen of *C. niveum*. The sporangia are branching plasmodiocarps, forming, as Berkeley says, "reticulate masses, the outer wall thick, white, the inner very thin, hyaline" ; the columella is only represented by the thickened orange-brown base of the sporangium ; the capillitium consists of rather delicate purplish branching threads, with scattered wart-like thickenings ; the spores measure 9 μ. The type of *C. physaroides* Rost., Mon., p. 170 (syn. *Diderma deplanatum* Fr., *Chondrioderma deplanatum* Rost., Mon., App., p. 17) is not represented in the Strassburg or British collections. *Diderma albescens* Phill. closely resembles the Strassburg type of *C. niveum* in its globose, crowded sporangia, with orange-brown inner wall and columella ; the capillitium is of rigid warted threads, intermixed with others more slender ; the spores are identical with those of Rostafinski's type, purple-brown, 9 to 11 μ diam. ; it is evidently the same species. The specimen here figured from Chiselhurst, named *D. deplanatum* Fr. by Broome (B. M. 27), connects all these forms ; its sporangia are either globose, or elongated plasmodiocarps, with capillitium exactly of the Strassburg type.

Hab. On dead leaves, sticks, etc.—Chislehurst, Kent (B. M. 27) ; Carlisle (L:B.M.58) ; Appin, Scotland (K. 410) ; Linlithgow (K. 1435) ; Vosges Mts. (Strassb. Herb.) ; Christiania (L:B.M.58) ; California (L:B.M.58) ; Brit. Columbia (K. 379).

8. **C. Lyallii** Mass., Mon., p. 201 (1892). Plasmodium ? Sporangia subglobose, sessile or shortly stipitate, aggregated, seated on a more or less strongly developed white hypothallus, 1 to 1·5 mm. diam., nearly smooth, roughened with minute scattered prominences ; sporangium-wall of two layers, the outer thick, densely charged with lime-granules, separating from the membranous inner wall, which is firm and usually orange at the base. Stalk short, stout, rugose, white or ochraceous. Columella cylindrical, or clavate and stipitate, ochraceous, sometimes attaining two-thirds the height of the sporangium. Capillitium of rigid dark violet-brown threads, branching and anastomosing, 1·5 to 2 μ broad. Spores dark violet-brown, spinose, 11 to 15 μ diam.

Plate XXXII., A.—*a.* sporangia, × 20 ; *b.* capillitium with fragment of sporangium-wall and spores, × 280 ; *c.* spore, × 600 (Switzerland).

Hab. On dead grass.—Switzerland (L:B.M.59) ; Oregon Boundary, U.S.A. (K. 380).

Sub-genus 2.—**Leangium.** Sporangia stipitate or sessile; sporangium-wall of two closely connected layers (which do not separate, except in *C. Sauteri*); the outer cartilaginous, more or less charged with innate minute lime-granules; the inner membranous, often dehiscing in revolute lobes from the naked globose mass of spores.

9. **C. Trevelyani** Rost., Mon., p. 182 (1875). Plasmodium? Total height 1 to 1·5 mm. Sporangia globose or subellipsoid, sessile or shortly stalked, verrucose or nearly smooth, 1 mm. diam., reddish or orange-brown; sporangium-wall splitting irregularly or in unequal, revolute, petal-like lobes, white on the inner side: of three inseparable layers, the outer one cartilaginous, brown; the inner delicately membranous, attached to the threads of the capillitium; the middle layer thick, composed of coarse irregular crystals of lime. Stalk equal, furrowed, 0·1 to 0·5 mm. high, 0·1 to 0·15 mm. thick, of the colour of the sporangium. Columella none. Capillitium profuse, purple or purplish-brown, somewhat rigid, forming a network with dark bead-like thickenings at the nodes and on the threads, rarely slender, with few thickenings. Spores dark violet-brown, spinulose, 10 to 13 μ diam.—Cooke, Myx. Brit., p. 40; Mass., Mon., p. 202. *Leangium Trevelyani* Grev., Scot. Crypt. Fl., tab. 132 (1825). *Diderma Trevelyani* Fr., Syst. Myc., iii., p. 105. *Chondrioderma Œrstedtii* Rost., Mon., p. 184, figs. 154, 157; Cooke, Myx. Brit., p. 41; Mass., Mon., p. 203. *Diderma geasteroides* Phill., in Grev., v., p. 113. *Chondrioderma geasteroides* Phill., in Mass., Mon., p. 201. *Diderma laciniatum* Phill., *l.c.*, p. 113.

Plate XXXII., B.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. fragment of sporangium-wall showing the cartilaginous and crystalline layers, × 280; *d*. spore, × 600 (California; type of *Diderma geasteroides* Phill.); *e*. sporangium, × 20 (Shrewsbury, England).

The crystalline middle layer of the sporangium-wall separates this from all other species of the *Leangium* group. The type specimen of *C. Trevelyani* described and figured under the name of *Leangium Trevelyani* in Greville's Scottish Crypt. Flor., tab. 132, is in the Edinburgh Herbarium; it is sessile on *Mnium undulatum*, and was gathered by W. C. Trevelyan, Esq., who also sent specimens to Mr. Sowerby. The specimen named *Diderma Trevelyani*, "Sowerby Herb." (K. 1478), is on *Mnium undulatum*, and is no doubt that referred to. Greville speaks of and figures a "very minute columella"; he was evidently mistaken on this point, and Berkeley in describing Trevelyan's gathering states: "I find no trace of a columella; the bottom of the peridium within is perfectly even." Examination of the type in the Edinburgh collection confirms Berkeley's statement. The specimen from Jedburgh (K. 1477) is marked by Rostafinski *Chondrioderma Oerstedtii*, and is given by him as a type of that species (Rost., Mon., App., p. 21); it has the characteristic capillitium and sporangium-wall of Greville's type. These characters are also present in *Diderma geasteroides* Phill. and *D. laciniatum* Phill., from California, in Herb. Phillips. These three specimens are clearly the same species as *C. Trevelyani*.

Hab. On dead leaves, moss, etc.—Herb. Bloxam (Leicester?) (B. M. 26); Jedburgh, Scotland (K. 1477); Northumberland (Edin. Herb., ex Herb. Grev.; K. 1478, ex Herb. Sowerby).

10. **C. Sauteri** Rost., Mon., p. 181 (1875). Plasmodium? Sporangia subglobose, depressed, sessile, somewhat aggregated, 0·7 to 1 mm. diam., smooth, pale pinkish-brown; sporangium-wall of two layers, the outer cartilaginous, thin, brittle, shining, more or less charged with innate lime-granules, separating from the membranous inner layer. Columella hardly evident, a rugose thickening of the base of the sporangium; reddish-brown. Capillitium not very abundant, of sparingly branched colourless or pale violet threads, 2 to 4 μ broad, persistent at the base. Spores dark violet-brown, spinulose, 10 to 13 μ diam.—Mass., Mon., p. 217. *C. aculeatum* Rex, in Proc. Acad. N. Sc. Phil. 1891, p. 390.

Plate XXXIII., A.—*a.* sporangia, × 20; *b.* capillitium, with fragments of sporangium-wall, × 280; *c.* spore, × 600 (Salzburg, Tyrol).

The specimen in the Strassburg collection named previously "*Diderma deplanatum*, ex. Herb. Sauter, ad muscos in montibus Salz." appears to be the type given by Rostafinski (Mon., p. 181), and is well described as "of coffee-and-milk colour, the outer wall brittle, separating from the inner, which is membranous and colourless." The species described by Dr. Rex as *C. aculeatum* (*l.c.*) (L:B.M.61) is identical in all its characters with *C. Sauteri*. The specimen in Greville's coll. in the Edinburgh Herb. named "*Diderma?* Appin. Carm." is the same form and probably part of the same gathering as K. 403, named "*Diderma melaleucum* Carm.," with a descriptive note stating that it was gathered in Scotland by Capt. Carmichael. It differs from the Salzburg and American gatherings in the rather darker and larger sporangia, and in the broader, almost simple threads of the more scanty capillitium, but it appears to be the same species.

Hab. On dead wood, moss, etc.—Appin, Scotland (K. 403); Salzburg, Tyrol (Strassb. Herb.); Philadelphia (L:B.M.61).

11. **C. radiatum** Rost., Mon., p. 182, figs. 152, 155, 156, 170 (1875). Plasmodium pale yellow, among dead fir and oak leaves, and stripped bark. Total height 0·7 to 1 mm. Sporangia subglobose, flattened or umbilicate beneath, stalked or sessile, smooth or somewhat wrinkled and rimose, 0·7 to 1·2 mm. diam., pale grey or brownish or red-brown, crowded or scattered; sporangium-wall breaking irregularly above, occasionally dehiscing from the naked globose mass of spores in revolute lobes, cartilaginous, obscurely granular, with a membranous inseparable inner layer. Stalk short, 0·2 to 0·5 mm. high, thick, yellowish-brown, charged throughout with white lime-deposits. Columella hemispherical or subglobose, 0·5 mm. diam., densely calcareous. Capillitium abundant, dark violet-brown, radiating from the columella in somewhat rigid threads, sparingly branched except at the colourless extremities, usually roughened with minute wart-like thickenings; rarely pale, delicate, and flexuose. Spores dark violet-brown, closely and minutely spinulose, 9 to 12 μ diam.—Cooke, Myx. Brit., p. 40; Blytt, Bidr. Norg., Sop. iii. (1892), p. 6; Mass., Mon.

p. 200. *Lycoperdon radiatum* Linn., Sp. Pl., ed. 2, p. 1654 (1763). *Diderma umbilicatum* Pers., Syn., p. 165; Engl. Fl., v., p. 310. *Didymium stellare* Schrad., Nov. Pl. Gen., p. 25 (1797). *Leangium stellare* Link, in Berlin Ges. Nat. Fr. Mag., iii., p. 26; Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 72. *Diderma Carmichælianum* Berk., Engl. Fl., v., p. 311. *Chondrioderma Carmichælianum* Cooke, Myx. Brit., p. 42; Mass., Mon., p. 202 (in part).

Plate XXXIII., B.—*a.* sporangia, × 20; *b.* capillitium and spores, × 280; *c.* spore, × 600 (England).

The development of lime varies in different gatherings and often in individuals of the same cluster; instead of the wall being obscurely granular, as is usually the case, it may be loaded with white granules, or these may be partially present, forming a white cap to a dark sporangium, or the sporangia may be dark brown with little or no deposit of lime in the wall. American specimens received from Dr. Rex differ from the European in the colourless flexuose capillitium and the more ovoid columella. *C. roanense* is describedas a new species by Dr. Rex (Proc. Acad. N. Sc. Phil., 1893, p. 368); the sporangia are umber-brown, resembling in this respect the dark forms of *C. radiatum* occasionally met with at Lyme Regis, but they are much depressed and almost orbicular in shape; the columella is convex and pale ochraceous; the short stalks are black; the capillitium is colourless, of the same character as in the American specimens of *C. radiatum*; the spores are similar to those of the latter species. It appears to be represented by a single gathering from Roan Mountain, Tennessee, and is allied to *C. radiatum*, as pointed out by Dr. Rex, who adds: "It differs from the other discoidal or orbicular species in the dark chestnut umber colour, its well-marked discoidal columella and jet-black irregular stipe." Until further gatherings are obtained to establish the constancy of the form, *C. roanense* may be regarded as a variety of *C. radiatum*.

Hab. On bark, twigs, etc.—Lyme Regis, Dorset (L:B.M.62); Boynton, Yorkshire (B. M. 1063); Poland (Strassb. Herb.); Norway (B. M. 531); Italy (B. M. 532); Virginia (L:B.M.62).

12. **C. rugosum** Rex, in Proc. Acad. N. Sc. Phil. 1893, p. 369. Plasmodium grey. Total height 0·7 to 1 mm. Sporangia subglobose or hemispherical, stipitate, scattered, 0·5 to 0·6 mm. diam., greyish-white, brown at the base, reticulated with wrinkles "which divide the wall into 25 to 30 irregularly polyhedral portions"; sporangium-wall single, papyraceous, with scanty deposits of lime in minute, scattered, angular fragments. Stalk subulate, 0·4 to 0·6 mm. high, furrowed, black. Columella clavate, about half the height of the sporangium, rugose, chalky or yellowish-white. Capillitium of delicate colourless threads, sparingly anastomosing and branching towards the tips. Spores violet-brown, minutely warted, 9 μ diam.

Plate XXXIV., A.—*a.* sporangia, × 20; *b.* capillitium, with fragment of sporangium-wall and spores, × 280; *c.* spore, × 600 (United States).

This species is, as stated by Dr. Rex, allied to *C. radiatum*; it has been found once in considerable abundance at Cranberry, N. Carolina.

Hab. On moss, etc.—N. Carolina (L:B.M.63).

13. **C. floriforme** Rost., Mon., p. 184 (1875). Plasmodium greyish-white. Total height 1 to 2 mm. Sporangia globose, stipitate, erect, smooth, crowded, 0·8 mm. diam., varying from white to ochraceous-brown; sporangium-wall splitting into several revolute petal-like lobes, ochraceous-brown on the inner side, cartilaginous, obscurely granular, with an inseparable membranous inner layer. Stalk equal, furrowed, 0·5 to 1 mm. long, 0·15 mm. thick, ochraceous-brown, rising from a strongly developed common hypothallus. Columella ovoid or hemispherical, brown, densely calcareous. Capillitium of slender, sparingly branching threads, with scattered bead-like thickenings, thicker and anastomosing at the base, dark violet-brown. Spores red violet-brown, with widely separated obtuse warts, 9 to 11 μ diam.—Cooke, Myx. Brit., p. 41 ; Mass., Mon., p. 198; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 149. *Sphærocarpus floriformis* Bull., Champ., p. 142, t. 371 (1791). *Diderma floriforme* Pers., in Röm., N. Mag. Bot., i., p. 89 (1794). *Leangium floriforme* Link, in Berlin Ges. Nat. Fr. Mag., iii., p. 26; Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 73.

Plate XXXIV., B.—*a*. sporangia moist and unexpanded, × 20; *b*. sporangia dry and expanded, × 20 ; *c*. capillitium and spores, × 280 ; *d*. spore, × 600 (England) ; *e*. sporangia expanded and showing clavate columellæ, × 20 (United States).

The red-brown spores with scattered warts distinguish this species from all forms of *C. radiatum*.

Hab. In crevices at the base of oak stumps, etc.—Epping Forest, Essex (L:B.M.64) ; Germany (B. M. 533) ; Ohio (L:B.M.64) ; Iowa (B. M. 817) ; S. Carolina (B. M. 925).

14. **C. Hookeri** Lister. Plasmodium? Sporangia subglobose, stipitate, erect, gregarious, 1 mm. diam., rufous with a slight iridescent lustre ; sporangium-wall of two layers, the outer cartilaginous, purplish-brown, closely combined with the colourless inner layer. Stalk equal from a broader base, furrowed, 0·7 mm. high, purplish-brown, densely charged with lime. Columella cylindrical, obtuse, rugose with the expanded bases of the capillitium, 0·4 mm. high, 0·17 mm. thick, purplish-brown, densely charged with lime. Capillitium of lax branching and anastomosing threads, nearly equal in breadth throughout, 2 μ diam., colourless or pale violet. Spores dark purple-brown, spinose, 13 to 15 μ diam.—*Diderma Hookeri* Berk., in Fl. Nov. Zel., p. 191 (1855). *Lamproderma Hookeri* Rost., Mon., App., p. 24. *Diachæa Hookeri* Mass., Mon., p. 260.

Plate XXXV., A.—*a*. remains of sporangia, on fern frond, natural size ; *b*. stalk and columella, × 20; *c*. capillitium, with portion of columella, containing lime-granules, × 280 ; *d*. spore, × 600 (New Zealand).

This is represented by a single gathering, and appears to have been in imperfect preservation when first examined by Berkeley. Rostafinski writes that it was in an injured state when seen by him ; probably it was then in much the same condition as at the present time. The specimen consists of a considerable number of sporangia on a frond of *Hymenophyllum*, but little remains beyond the stalks and columellæ

with the bases of the sporangium-walls; they had, apparently, been exposed to weather before gathering, as the tangle of capillitium, where any remains, is closely wound about the columella, as if from the effect of rain. From the structure of the sporangium-wall and capillitium Berkeley was clearly right in placing it as a *Diderma*. The substance of the outer layer is very similar to that of *C. Sauteri*, and there is a strong resemblance to that species in the large spinose spores and the pale, rather broad threads of the wavy capillitium; it differs in the presence of the stalk and cylindrical columella, which contain dense deposits of lime extending for some distance into the hypothallus.

Hab. On *Hymenophyllum*.—New Zealand (K. 1559, L:B.M.65 slide).

15. **C. lucidum** Cooke, Myx. Brit., p. 42 (1877). Plasmodium? Sporangia subglobose, sessile or occasionally stipitate, scattered, 0·7 mm. diam., bright reddish-yellow, shining, dehiscing in more or less petaloid lobes; sporangium-wall of two layers without deposits of lime, the outer cartilaginous, closely combined with the membranous inner layer. Stalk very short, 1 mm. high, in one instance 3 mm. high, brown, slender. Columella irregularly globose, 0·35 mm. diam., seated on a narrow stalk, rugose and pitted, ochraceous. Capillitium not abundant, of irregular purple-brown threads 2 to 5 μ diam., branching and anastomosing, with wide expansions at the axils. Spores dark purple-brown, closely spinulose, 12 to 14 μ diam.—Mass., Mon., p. 204. *Diderma lucidum* Berk. & Br., in Ann. Mag. Nat. Hist., ser. 3, vii., p. 380 (1861). *Chondrioderma Carmichœlianum*, Mass., Mon., p. 202 (in part).

Plate XXXV., A.—*e*. sporangia, × 20; *f*. broken sporangium showing stalked columella, from mounting in glycerine, × 20; *g*. capillitium and spores, × 280; *h*. spore, × 600 (Trefriw, Wales).

In Berkeley's description of this species (*l.c.*) two localities are given: Trefriw, Wales, and Cumberland. Examples of the former gathering are met with in Broome's coll. (B. M. 25), named "*Diderma lucidum*," and in Berkeley's collection at Kew, named "*Diderma Carmichaelianum*, ex Herb. Broome" (K. 353). From the irregular character of the capillitium, and the absence of lime-deposits in the sporangium-wall and columella, it is possible that this is not a normal development, but an unusual form of some other known species.

Hab. On moss.—Trefriw, Wales (B. M. 25).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

16. **C. fallax** Rost., Mon., p. 171 (1875). Sporangia seated on a common hypothallus, crowded, but not closely compacted, sessile, globose, chalk-white; columella either small flattened or distinct ovate; capillitium fasciculate below, becoming very diffuse above, dull violet; spores dull violet, strongly spinulose, 12 to 14 μ diam.

Hab. Near Salzburg, Tyrol (Sauter).
May not this be a form of *C. globosum*?

17. **C. anomalum** Rost., Mon., p. 169. Plasmodiocarps venulose, creeping, very convex, variously contorted, superficially minutely

granular, brown below, colourless above; columella strongly developed, following the windings of the plasmodiocarp, pale brown; capillitium of slender lax colourless threads combined into a dense net; spores nearly smooth 11·6 to 13·8 μ diam.

Hab. Kiew, Russia (Prof. Walza).

The colour of the spores is not given by Rostafinski. Except for the large size of the spores this description applies nearly to *C. reticulatum*.

18. **C physaroides** Rost., Mon., p. 170. Sporangia sessile, irregularly rounded, 1 to 3 mm. diam., convex or somewhat depressed, mutually compressed, chalk-white; sporangium-wall densely charged with lime; columella none, or inconspicuous, depressed, dirty ochraceous; capillitium inconspicuous, of delicate slender hyaline threads combined into a net; spores violaceous, with scattered warts, 12·5 μ diam. *C. deplanatum* Rost., Mon., App., p. 17.

Hab. The specimen described was gathered near Geneva by De Candolle (father and son).

This description does not correspond with that of *Diderma deplanatum* Fr., which is given by Rostafinski as a synonym.

19. **C. Friesianum** Rost., Mon., p. 173. Sporangia sessile, hemispherical, depressed, snow-white from the abundant deposits of lime; when the outer wall has fallen away, ash-grey; columella distinct, lenticular, depressed, yellowish or flesh-coloured; capillitium well-developed, colourless, the threads combined into a net; spores pale violet, smooth, 8 μ diam. Very nearly allied to *C. Michelii*.

Hab. Muenchau, near Hattenheim (Fuckel).

Sessile forms of *C. Michelii* agree with this description.

20. **C. calcareum** Rost., in Fuckel, Symb., Nachtr., p. 74 (1873). Sporangia sessile, depressed, irregularly angled, forming vein-like plasmodiocarps, chalk-white; outer sporangium-wall shell-like, brittle, easily falling away, the inner wall appearing violet-black from the colour of the spores seen through its transparent membrane; columella inconspicuous, depressed, ochre-yellow; capillitium abundant, of dull violet threads branched and forked, combined into a net; spores delicately warted, 9·2 to 11·5 μ diam. Mon., p. 179.

Hab. Glacko (Link), Schendau (Schmidt), Fuckel.

There can be little doubt from the description that this species is a form of *Didymium difforme* with abundant dark capillitium.

21. **C. vaccinum** Rost., Mon., p. 180. Sporangia sessile, globose, depressed, the outer wall shell-like, leather-coloured; the inner transparent, iridescent; columella large, distinct, dusky; capillitium of delicate, colourless, simple threads; spores dull brownish violet, warted, 10·8 to 11·6 μ diam. The outer sporangium-wall is

wrinkled and irregularly reticulated, brownish-yellow; the inner colourless; the large columella is filled with crystalline deposits of lime.

Hab. On fallen branches of *Opuntia*.—Algiers (Durieu).
This description applies to a dark form of *C. testaceum*.

22. **C. Stahlii** Rost., Mon., p. 185. Sporangia spherical, slightly flattened at the base, either dull, brownish-white, or shining and dull brown; dehiscing either by a round central opening, or by an oblong fissure, or irregularly; stalk brown, shining; columella entirely wanting; capillitium of dull violet threads 1·2 to 2·3 μ thick, at first simple, branching several times towards the tips, but not uniting into a net; spores pale violet, faintly warted, 9·2 μ diam.

Hab. Near Strassburg (Dr. Stahl).
This description suggests a form of *C. radiatum*, in which the columella varies in shape and size.

23. **C. leptotrichum** Racib., in Rozpr. Mat.-Przyr. Akad. Krak., xii., p. 75 (1884). Sporangia vein-like, or irregular, flattened; sporangium-wall simple, covered with small calcareous scales; columella none; capillitium of delicate threads 0·83 μ diam., forming a flaccid dense net, which can easily be drawn out of the plasmodiocarp; spores blackish-brown, 12·5 to 13·2 μ diam., minutely warted.

Hab. Near Cracow, Poland.
The scaly wall of this species suggests that it may be a plasmodiocarp form of *Didymium squamulosum*.

24. **C. exiguum** Racib., in Hedw., xxviii., p. 118 (1889). Sporangia minute, stipitate, 0·3 to 0·4 mm. diam., hemispherical, flattened beneath, grey, iridescent; stalk once or twice the height of the sporangium, very slender, furrowed, narrower and curved above, yellow, without deposits of lime; sporangium-wall simple, with little lime, persistent and yellow beneath, hyaline and breaking irregularly above; capillitium of slender hyaline threads 0·4 μ wide, branched and anastomosing, expanded at the axils, but without lime deposits; spores violet, minutely warted, 7 to 8 μ diam. Resembling certain species of *Tilmadoche*, of which it may be a form with little lime.

Hab. On bark.—Near Cracow.
The description applies to *Physarum nutans* v. *violascens*.

25. **C. simplex** Schroeter, Krypt. Fl. Schles., iii., p. 123 (1885). Sporangia globose, somewhat depressed, solitary; sporangium-wall simple, brittle, bright chocolate-brown; columella wanting; capillitium radiating, repeatedly branched, violet; spores violet, smooth, 7 to 9 μ diam.

Hab. On old stumps.—Fürstenstein, Silesia.

26. **C. mutabile** Schroeter, *l.c.*, p. 123. Sporangia sessile, irregular in shape, hemispherical, depressed, or curved and elongated 1 to 3 mm. long, 1 mm. broad; sporangium-wall shell-like, brittle, clear greyish-brown; columella strongly developed, following the shape of the plasmodiocarp, bright red-brown; capillitium of slender violet threads, with scattered knot-like thickenings; spores dark violet, spinulose, 11 to 14 μ diam.

Hab. On dead wood.—Oppeln, Silesia.
This description applies to *C. niveum* v. *deplanatum*.

27. **C. ochraceum** Schroeter, *l.c.*, p. 124. Sporangia sessile, globose, or half-ring shaped, 1 to 2 mm. long, 1 mm. broad, crowded; the outer sporangium-wall ochre-brown, opaque, breaking up irregularly, the inner delicate, colourless; columella wanting; capillitium well-developed, of smooth violet threads 2 to 3 μ diam., branching and combined into a dense net; spores dark violet, faintly warted, 9 to 11 μ diam.

Hab. On liverwort.—Riesengebirge, Silesia.
The description suggests a form of *C. testaceum*.

SPECIES EXCLUDED FROM THE GENUS.

C. Alexandrowiczii Rost.	= *Didymium squamulosum* Fr.
C. Berkeleyi Rost.	= *Trichamphora pezizoidea* Jungh.
C. Cookei Rost.	= *Didymium squamulosum* Fr.
C. difforme Rost.	= *Didymium difforme* Duby.
C. liceoides Rost.	= *Didymium difforme* Duby.
C. Muelleri Rost.	= *Trichamphora pezizoidea* Jungh.
C. pezizoides Rost.	= *Trichamphora pezizoidea* Jungh.
C. Zeylanicum Rost.	= *Trichamphora pezizoidea* Jungh.

Genus 10. — **TRICHAMPHORA** Junghuhn, Fl. Crypt. Jav., p. 12 (1838). Sporangia discoid or saucer-shaped, stipitate; sporangium-wall membranous with evenly distributed deposits of innate lime-granules. Capillitium of colourless branching threads, without lime.

1. **T. pezizoidea** Jungh., *l.c.* (1838). Plasmodium? Total height 1 to 2·5 mm. Sporangia discoid or saucer-shaped, stipitate, erect or somewhat inclined, scattered, 0·8 to 1·3 mm. broad, 0·2 to 0·4 mm. thick, pale grey; sporangium-wall membranous, with thin innate deposits of lime equally distributed, breaking up into areolæ and remaining attached to the capillitium after the dispersion of the spores. Stalk subulate, longitudinally striate, orange-red, translucent. Columella none. Capillitium of branching, anastomosing colourless threads, with broad expansions at the axils and at the attachment to the sporangium-wall, without lime-knots. Spores dull violet-brown, more or less spinulose, 9 to 15 μ diam.—*Chondrioderma pezizoides* Rost., Mon., p. 424, fig. 122. *Physarum Muelleri* Berk., M.S. in Herb. *Chondrioderma Muelleri*

Rost., Mon., App., p. 15. *Didymium Zeylanicum* Berk. & Br., in Linn. Journ., xiv., p. 84; Mass., Mon., p. 240. *Chondrioderma Zeylanicum* Rost., Mon., App., p. 15. *Chondrioderma Berkeleyanum* Rost., Mon., App., p. 16; Mass., Mon., p. 214. *Trichamphora Fuckeliana* Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 71; Mon., p. 138. *Badhamia Fuckeliana* Rost., Mon., App., p. 2; Mass., Mon., p. 321. *Didymium australis* Mass., Mon., p. 237.

Plate XXXV., B.—*a*. sporangia, × 20; *b*. capillitium, with fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (Australia).

The fine specimen from Sumatra in the Leyden Herb., covering an area of six inches on a frond of *Selaginella stipulata*, a part of which, through the kindness of Dr. Boerlage, is in this collection (L:B.M.67), may be taken as a type of this interesting species. From the unique characters of the sporangium and capillitium, it deserves to retain the generic position assigned to it by Junghuhn in describing the original Java specimen. Examination of the scanty remains of that gathering at Strassburg and at Leyden, and of the types of *Physarum Muelleri* Berk. from Queensland and Ceylon (K. 1433 and 1432), also of *Didymium Zeylanicum* Berk. & Br. from Ceylon (B. M. 576), and of *Didymium australis* Mass. from Brisbane (K. 1491), shows that they all possess the characters given above, and are consequently included under *T. pezizoidea*. The specimen marked *Physarum macrocarpum* Ces., No. 1458, Fuckel F. Rhen. (B. M. 403), is a part of Rostafinski's type of *Badhamia Fuckeliana* Rost., of which a fine example is in Strassb. Herb.; it is essentially identical with the Sumatra gathering of *T. pezizoidea*. The type of *Chondrioderma Berkeleyanum* Rost. from Tahiti in the Kew collection (K. 1207A), marked in pencil by Berkeley *Trichamphora pezizoidea* Jungh., differs from Fuckel's gathering only in the darker and more strongly spinose spores; the number of spines on the hemisphere is the same in each; in the Sumatra specimen the spores are intermediate in colour and in the strength of the spines, while in the Brisbane specimen the spores are nearly smooth. This varying character is not sufficient to raise the Tahiti gathering to the rank of a distinct species. A fine growth from Borneo has dark spinose spores 15 μ diam.

Hab. On dead wood, leaves, etc.—Germany (B. M. 403); Natal (K. 376); Ceylon (B. M. 576); Java (Strassb. Herb.); Sumatra (L:B.M.67); Borneo (L:B.M.67); Queensland (L:B.M.67); Tahiti (K. 1207).

Genus 11.—**DIACHÆA** Fries, Syst. Orb. Veg., i., p. 143 (1825). Sporangium-wall hyaline, iridescent, without deposits of lime. Stalk and columella charged with granules of lime. Capillitium a profuse network of purplish threads, without lime-knots.

KEY TO THE SPECIES OF *DIACHÆA*.

Lime in stalk and columella white.	
Spores nearly smooth.	1. *D. elegans*
Spores tuberculated.	2. *D. splendens*
Lime in stalk and columella orange.	3. *D. Thomasii*

1. **Diachæa elegans** Fries, *l.c.* (1825). Plasmodium opaque white. Total height 1 to 1·3 mm. Sporangia cylindrical, obtuse or subglobose, stipitate, erect, gregarious, 0·7 mm. high by 0·25 mm. broad, deep iridescent blue; sporangium-wall membranous, hyaline. Stalk stout, brittle, furrowed, one-third or one-half the height of the sporangium, broad at the base, rising from a well developed hypothallus, densely charged with round lime-granules 2 to 4 μ diam., snow-white. Columella cylindrical, narrowed upwards, reaching half-way or nearly to the apex of the sporangium, white, densely charged with lime. Capillitium of profusely branched and anastomosing threads connecting the columella with the sporangium-wall, dark violet-brown, colourless at the extremities. Spores dull violet, minutely spinulose, 7 to 9 μ diam. —Fr., Syst. Myc., iii., 156; Berk., in Ann. Mag. Nat. Hist., ser. 1, i., p. 257; Cooke, Handb., p. 395. *Trichia leucopoda* Bull., Champ., p. 121, t 502, fig. 2. *Diachæa leucopoda* Rost., Mon., p. 190, fig. 178; Cooke, Myx. Brit., p. 44; Mass., Mon., p. 259. *D. confusa* Mass., Mon., p. 259. *Didymium bulbillosum* Berk. & Br., in Linn. Journ., xiv., p. 84.

Plate XXXVI., A.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spore, × 600 (England).

The type specimen of *D. confusa* Mass., from Jamaica, does not appear to differ from *D. elegans*; the spores measure 7 to 8 μ, the usual size in that species; they are free except when combined in masses by mould. The type specimen of *Didymium bulbillosum* Berk. & Br., from Ceylon (B. M. 592), is a form of *D. elegans* with globose sporangia; the lime in the stalk is in the form of angular lumps, while the columella is without lime; the spores are more spinulose than in typical *D. elegans*, but not tuberculated as in *D. splendens*.

Hab. On dead leaves.—Wanstead, Essex (L:B.M.66); France (Paris Herb.); Germany (B. M. 580); Poland (Strassb. Herb.); Bohemia (B. M. 584); Natal (K. 433); India (B. M. 590); Ceylon (B. M. 592); Ohio (L:B.M.66); S. Carolina (B. M. 848); Cuba (K. 438); Jamaica (Herb. Massee); Chili (Strassb. Herb.); Paraguay (Paris Herb.).

2. **D. splendens** Peck, in Rep. N. York Mus. Nat. Hist., xxx., p. 50 (1878). Similar to the globose form of *D. elegans*, except that the spores are provided with dark raised bands and tubercles.—Mass., Mon., p. 261; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 143.

Plate XXXVI., A.—*d*. sporangia, × 20; *e*. capillitium and spores, × 280; *f*. spores, × 600 (United States).

Hab. On dead leaves.—Massachusetts, U.S.A. (L:B.M.69); Iowa (L:B.M.69).

3. **D. Thomasii** Rex, in Proc. Acad. N. Sc. Phil. (1892), p. 329. Plasmodium rich yellow. Sporangia globose, shortly stalked or sessile, scattered or crowded on a common orange hypothallus, 0·6 to 0·7 mm. diam., iridescent copper-coloured or violet-blue; sporangium-wall membranous, hyaline. Stalk short, stout, rich orange, densely charged with orange lime-granules. Columella

stout, conical, or shortly cylindrical, densely charged with orange lime-granules. Capillitium radiating from all parts of the columella, composed of rather rigid violet-brown threads, branching and anastomosing, tapering to the hyaline extremities. Spores olive-coloured, marked with small scattered warts, and four to eight prominences, each of which a high magnifying power resolves into a compact cluster of minute warts, 9 to 11 μ diam.

Plate XXXVI., B.—*a*. sporangia, × 20; *b*. capillitium and spores, × 280; *c*. spores, × 600 (North Carolina, U.S.A.); *d*. sporangia, × 20; *e*. columella and capillitium, × 50; *f*. spore, × 600 (Killary, U.S.A.).

The specimen figured (Plate XXXVI., B, *d-f*) was received from Prof. Farlow, and is part of a gathering by Prof. Thaxter, Killery, U.S.A. The sporangia are sessile, subcylindrical, crowded and somewhat angled by mutual pressure, iridescent, rising from an opaque ochraceous common hypothallus, which extends into a membranous pellicle; the sporangium-wall is persistent, membranous, hyaline or dull purple at the base; the columella is a narrow, membranous, wrinkled tube, dirty ochraceous or brown, reaching nearly to the apex of the sporangium, empty above, with scanty deposits of lime sometimes present in the lower part; the capillitium and spores are as in *D. Thomasii*. Prof. Farlow has gathered this form more than once, growing in tufts, on moss, always in poor condition, but with the ochraceous hypothallus, narrow columella, and capillitium and spores similar to those in the gathering by Prof. Thaxter. A portion of Prof. Thaxter's specimen was submitted to Dr. Rex, who states that it is the same species as one described by Dr. Sturgis as *Comatricha cæspitosa* n. sp. in Bot. Gazette, xviii., p. 186 (1893). The membranous columella almost free from lime, resembling some Ceylon specimens of *D. elegans*, and the opaque ochraceous hypothallus, mark the species as distinct from any of the *Stemonitaceæ*; on the other hand, it so closely resembles *D. Thomasii* that it appears to be a form of that species, though less perfectly developed than the type.

Hab. On bark and moss.—N. Carolina (L:B.M.70).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

4. **D. subsessilis** Peck, Rep. N. York Mus. Nat. Hist., xxxi., p. 41. Sporangia gregarious or crowded, subglobose, sessile or with very short white stalks; sporangium-wall delicate, iridescent; columella obsolete; capillitium and spores violet-brown; spores globose, rough, 10 to 12 μ diam.

Hab. On fallen leaves.—Adirondack Mts., N.Y.

The spores of this species, according to Dr. Rex, are marked with diffusely branched rows of minute papillæ, ranged side by side in a moniliform manner, and forming either a complete or broken reticulation. (See Rex, in Proc. Acad. N. Sc. Phil., 1893, p. 368.)

SPECIES EXCLUDED FROM THE GENUS.

Diachæa Hookeri Mass. = *Chondrioderma Hookeri* List.

Order II.—Didymiaceæ. Deposits of lime in crystals or crystalline discs distributed over the sporangium-wall; capillitium without lime-knots; sporangia simple, except in *Spumaria*, where they are combined into an æthalium.

KEY TO THE GENERA OF *DIDYMIACEÆ*.

Lime-crystals stellate, distributed over the sporangium-wall.

(12) Didymium.

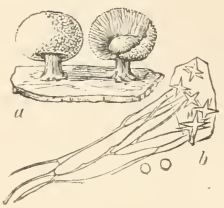

Fig. 20.

Fig. 20.—*Didymium effusum* Link.

a. Two sporangia, one entire, the other showing columella and capillitium. Magnified 12 times.

b. Capillitium and fragment of sporangium-wall, with crystals of calcium carbonate and two spores. Magnified 200 times.

Lime-crystals heaped together, at first concealing the confluent hollow sporangia.

(13) Spumaria.

Fig. 21.

Fig. 21.—*Spumaria alba* DC.

a. Æthalium. Natural size.

b. Capillitium and fragment of sporangium-wall, with crystals of calcium carbonate and two spores. Magnified 200 times.

Lime-crystals lenticular, marked with radiating striæ, scattered over the sporangium-wall.

(14) Lepidoderma.

Fig. 22.

Fig. 22.—*Lepidoderma tigrinum* Rost.

a. Sporangium. Magnified 6 times.

b. Capillitium and spores. Magnified 140 times.

Genus 12.—**DIDYMIUM** Schrader, Nov. Gen. Plant., p. 20 (1797). Sporangia stalked, sessile, or plasmodiocarps, not forming an æthalium; sporangium-wall membranous, beset with

superficial crystals of lime either scattered over the surface or combined into a separable crust; capillitium of branching threads, which are often thickened at intervals with dark calyciform nodes, without lime-knots.

KEY TO THE SPECIES OF *DIDYMIUM*.

A. Superficial crystals closely combined to form a thin shell-like crust:—

Capillitium scanty, usually broad at the base. 1. *D. difforme*

Capillitium profuse, slender at the extremities. 2. *D. dubium*

B. Superficial crystals scattered or loosely combined:—

A. Plasmodiocarps, capillitium associated with large, olive-coloured vesicles. 3. *D. Serpula*

B. Sporangia usually stalked, capillitium without large vesicles—

a. Sporangia disc-shaped, columella absent. 4. *D. Clavus*

b. Sporangia subglobose—

Stalk and columella dark brown, stalk opaque and granular. 5. *D. farinaceum*

Stalk olive-brown or orange, hornclear. 6. *D. nigripes*

Stalk and columella white; crystals on sporangium-wall scattered or forming a wrinkled crust. 7. *D. effusum*

Columella nearly white, stalk when present membranous; crystals on sporangium-wall forming a smooth, thick, deciduous envelope enclosing the pale membranous stalk. 8. *D. crustaceum*

1. **D. difforme** Duby, Bot. Gall., ii., p. 858 (1830). Plasmodium colourless or pale yellow. Sporangia pulvinate on a broad base or irregularly elongated and forming plasmodiocarps, scattered, 0·4 to 2 mm. or more long, smooth, white; sporangium-wall of two layers, the outer a thin crust of densely combined minute crystals of lime, separating from the iridescent membranous inner layer, which is purplish or nearly colourless above, stout and yellowish-brown at the base, thickened at the margin. Columella none. Capillitium often very scanty, of coarse or delicate, purple or colourless, flattened threads, usually broad at the base, branching dichotomously and slender above. Spores dark purple-brown, faintly warted, 11 to 14 μ diam.—*Diderma difforme* Pers., Disp. Meth., p. 9 (1797). *Chondrioderma difforme* Rost., in Fuckel, Symb., Nachtr., p. 73; Mon., p. 177; Cooke, Myx. Brit., p. 39; Lister, in Ann. Bot., vol. iv., No. xiv., p. 282

Mass., Mon., p. 212; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 6. *Didymium Libertianum* de Bary, Mycetozoa, p. 124. *Diderma liceoides*, Fr., Syst. Myc., iii., p. 107. *Licea macrospora* Schwein., in Trans. Am. Phil. Soc. (1834), p. 258. *Chondrioderma liceoides* Rost., Mon., App., p. 17; Mass., Mon., p. 215.

Plate XXXVII., A.—*a*. sporangia, × 20; *b*. capillitium attached to the sporangium-wall, which shows the thickened margin of the base passing into the membranous upper wall, × 280; *c*. portion of the crystalline crust of lime, × 280; *d*. delicate capillitium, × 280; *e*. spore, × 600 (England).

This species is removed from *Chondrioderma*, where it was placed by Rostafinski, on account of the crystalline character of the lime forming the outer crust of the sporangium-wall. It is to be regretted that there is no type of *C. calcareum* Rost. in Strassb. Herb., for the description in Rostafinski's Monograph answers well for the forms of *D. difforme* with well developed capillitium; as the latter species is given by Rostafinski as being almost destitute of capillitium, it is possible that *C. calcareum* is not entitled to specific rank. The type specimen of *Chondrioderma liceoides* Rost. (K. 1206) from the Schweinitz Herb., marked *Licea macrospora* by Schweinitz, is *Didymium difforme*; the structure of the sporangium-wall and the characters of the capillitium and spores are quite typical.

Hab. On dead leaves and herbaceous stems.—Wanstead, Essex (L:B.M.71); Welshpool, Montgomery (B. M. 1062); France (K. 386); Germany (B. M. 507, 521, 524, 529); Belgium (K. 401); Italy (B. M. 527); India (K. 1466); Seychelles (K. 1467); Carolina (K. 1206).

2. **D. dubium** Rost., Mon., p. 152 (1875). Plasmodium watery white, among dead leaves. Sporangia rounded or irregular plasmodiocarps, depressed, solitary, 1 to 12 mm. broad, 0·13 mm. thick; sporangium-wall of two layers, the outer consisting of large stellate crystals combined to form a fragile uneven crust, more or less attached to the delicate membranous inner layer. Columella none. Capillitium of profuse, rigid, erect, dark purplish-brown threads, anastomosing chiefly above and below, and attached at either end by colourless slender branches to the sporangium-wall. Spores violet-grey, spinulose or nearly smooth, 8 to 15 μ diam.—Cooke, Myx. Brit., fig. 167; Lister, in Journ. Bot. (1891), p. 261; Mass., Mon., p. 246. *Didymium Listeri* Mass., Mon., p. 244.

Plate XXXVII., B.—*a*. sporangia, × 20; *b*, *c*, *d*, *e*. various forms of capillitium, and spores, × 280; *f*. fragment of sporangium-wall, showing the crystalline outer layer, × 280; *g*. spore, × 600 (England).

This species is abundant at Lyme Regis, where it presents considerable variation. In many gatherings the spores are nearly smooth, measuring 8 to 10 μ diam., in others spinulose, 12 to 15 μ diam.; the capillitium may differ from the usual form in being flexuose with bead-like or irregular thickenings and with short free branches. Specimens submitted to Rostafinski are pronounced by him to be distinct from the original Hauenstein gathering in having smoother spores and more slender capillitium without thickenings; considering the variation mentioned above, these distinctions cannot be accepted as sufficient to mark the Lyme Regis form as a distinct species.

Hab. On dead leaves.—Lyme Regis, Dorset (L:B.M.72)

3. **D. Serpula** Fries, Syst. Myc., iii., p. 126 (1829). Plasmodium lemon-yellow, among dead leaves. Sporangia depressed effused plasmodiocarps, 2 to 8 mm. broad, 0·1 to 0·15 mm. thick, or perforated and net-like, or vermiform, grey; sporangium-wall membranous, colourless, with scattered superficial stellate crystals of lime. Columella none. Capillitium of very slender, somewhat branching and anastomosing, pale violet threads, connected with numerous subglobose vesicles 20 to 50 μ diam. filled with yellow, obscurely granular matter. Spores pale violet-brown, minutely warted, 7 to 9 μ diam.—Rost., Mon., App., p. 21. *Lycoperdon complanatum* Batsch, Elench. Fung., Cont. i., p. 251 (1786). *Didymium complanatum* Rost., Mon., p. 151; Cooke, Myx. Brit., p. 30.

Plate XXXVIII., A.—*a.* plasmodiocarp, × 2; *b.* section of the same, showing the capillitium and large vesicles, × 80; *c.* capillitium and spores, × 280; *d.* spore, × 600 (England).

The drawing of the capillitium in Mr. Massee's Monograph (fig. 56) does not represent the characteristic vesicles of *D. Serpula*, and the specimens from Kew, Batheaston, and Carlisle quoted by him (p. 234) are plasmodiocarp forms of *D. effusum*, which *D. Serpula* superficially resembles. These vesicles are frequently traversed by the capillitium threads, and are apparently formed later; they are minutely warted, like the spores.

Hab. On dead leaves.—Lyme Regis (L:B.M.73); Freiburg, Germany (L:B.M.73); Germany (B. M. 534, Strassb. Herb.); America (L:B.M. 73).

4. **D. Clavus** Rost., Mon., p. 153 (1875). Plasmodium grey. Total height 0·4 to 0·8 mm. Sporangium disc-shaped on a central stalk, erect, scattered, 0·7 to 1 mm. diam., 0·2 mm. thick, greyish-white; sporangium-wall membranous, more or less spotted with reddish-brown above, and beset with superficial clusters of stellate crystals of lime, thicker and brown at the base. Stalk cylindrical, longitudinally striate, pale brown or black. Columella none, or represented only by the thickened base of the sporangium. Capillitium profuse, of sparingly branched colourless or purple-brown threads. Spores pale violet-brown, almost smooth, 6 to 8 μ diam.—Cooke, Myx. Brit., p. 30; Mass., Mon., p. 230; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 6. *Physarum Clavus* Alb. & Schw., Consp. Fung., No. 267 (1805). *Didymium melanopus* β *Clavus* Fr., Syst. Myc., iii., p. 114. *Didymium neglectum* Mass., Mon., p. 231. *Didymium commutabile* Berk. & Br., in Journ. Linn. Soc., xiv., p. 83; Rost., Mon., App., p. 21. *Didymium radiatum* Mass., Mon., p. 229 (in part).

Plate XXXVIII., B.—*a.* sporangia, × 20; *b.* capillitium attached above and below to the sporangium-walls, with spores, × 280; *c.* spore, × 600 (England).

The characters of the type specimen of *D. commutabile* Berk. & Br. (B. M. 537) agree in all respects with those of *D. Clavus*, except that the stalk is 1·5 mm. long, and is encrusted with deposits of lime. The type of *D. neglectum* Mass., from Philadelphia, growing with *Physarella mirabilis* in Herb. Massee, is a slender form of *D. Clavus*: in all

the specimens the upper wall is broken and the spores are shed, but sufficient remains to indicate the discoid form of the sporangia; the sporangium-wall is faintly mottled with brown; the capillitium is delicate, the spores pale violet-brown, 5 to 6 μ diam.

Hab. On dead leaves, etc.—Batheaston, Somerset (B. M. 80); Lyme Regis, Dorset (L:B.M.74); Wanstead, Essex (L:B.M.74); Germany (Strassb. Herb.); Ceylon (B. M. 537); Philadelphia (L:B.M.74).

5. **D. farinaceum** Schrad., Nov. Gen. Pl., p. 26 (1797). Plasmodium grey, among dead leaves, on bark, etc. Total height 0·5 to 1 mm. Sporangia subglobose or hemispherical, deeply umbilicate beneath, stipitate, gregarious, 0·6 to 1 mm. diam., or nearly sessile and confluent, white or grey; sporangium-wall firm, mottled with purple-brown, beset with stellate crystals of lime. Stalk cylindrical with a broad base, striate, dark brown, rarely rufous, 0·2 to 0·7 mm. long, 0·05 to 0·2 mm. thick, opaque and granular when mounted in glycerine. Columella large, hemispherical, umbilicate, dark brown, chambered, containing coarse granules of lime. Capillitium of stout or delicate, sparingly branched or simple, more or less flexuose threads, colourless or purplish-brown, with dark calyciform thickenings. Spores dark purplish-brown or purplish-grey, with a thick spore-wall, nearly smooth or spinose, 7 to 11 μ diam.—Rost., Mon., p. 154; Cooke, Myx. Brit., p. 31; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 7; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 146; Mass., Mon., p. 219. *Spumaria physaroides* Pers., Syn. Fung., p. 163. *Didymium physaroides* Fr., Symb. Gast., p. 21; Rost., Mon., p. 158; Cooke, Myx. Brit., p. 33; Mass., Mon., p. 233.

α. **genuinum**: threads of capillitium 2 μ thick; spores 9 to 11 μ diam.

β. **minus**: threads of capillitium 1 μ thick; spores 7 to 9 μ diam.

Plate XXXIX., A.—*a.* sporangia *α. genuinum*, × 20; *b.* capillitium and spores, with fragment of sporangium-wall and lime-crystal, × 280; *c.* spore, × 600 (England); *d.* sporangia *β. minus*, × 20; *e.* the same with heads confluent; *f.* capillitium and spores, × 280 (England).

Intermediate varieties uniting vars. *β* and *α* are so frequent that the former cannot be regarded as a distinct species. It is, however, very constant in its characters from different parts of the world, being marked by the smaller size and delicate capillitium. It often bears a considerable resemblance to *D. nigripes*, and is named *D. microcarpum* Rost. in some specimens in Strassb. Herb.; the opaque granular stalk distinguishes it from that species and its allies. Rostafinski's specimen of *D. physaroides* in Strassb. Herb. appears to be an imperfect development of *D. farinaceum*, as indicated by the spores, many of which are abnormal in shape and size, 15 to 50 μ long, combined in agglutinated masses, and by the capillitium, which contains vesicular expansions filled with lime-granules such as are not unfrequent in imperfect growths of *Didymium*; the sporangia are mostly clustered and confluent, but in some cases they are solitary; the columella is dark brown and chambered, and the sporangium-wall is mottled with purple-brown.

The specimens K. 471 to 474, called *D. physaroides*, differ in no respect from the common, nearly sessile form of *D. farinaceum* ; with a few exceptions the sporangia are confluent at their margins, but confluent sporangia are often met with in *D. farinaceum*.

Hab. On dead leaves, bark, etc.—Highgate, London (B. M. 1068); *a.* and *β.* Lyme Regis, Dorset (L:B.M.75) ; *a.* Ascot, Berks (B. M. 70) ; *a.* France (K. 6) ; *a.* Germany (B. M. 422) ; *a.* Maine, U.S.A. (K. 487) ; *a.* and *β.* Ohio (L:B.M.75) ; *a.* S. Carolina (B. M. 889) ; *β.* S. Carolina (B. M. 893).

6. **D. nigripes** Fries, Syst. Myc., iii , p. 119 (1829). Plasmodium grey, among dead leaves. Total height 1 to 1·5 mm. Sporangia hemispherical, umbilicate beneath, stipitate, erect, gregarious, 0·5 to 0·7 mm. diam., white; sporangium-wall membranous, mottled with brown, or colourless, beset with stellate crystals of lime. Stalk cylindrical, one to three times the height of the sporangium, longitudinally striate, varying in colour from dark olive-brown to orange, hornclear. Columella subglobose, dark brown, orange, or white, filled with irregular angular granules of lime. Capillitium of delicate colourless or purplish-brown branching threads. Spores pale violet-brown, nearly smooth, 8 to 11 μ diam.—Berk., in Sm. Engl. Fl., Fungi, p. 313. *Physarum nigripes* Link, in Berl. Mag., iii., p. 27 (1809); Ditm., in Sturm, Deutsch. Fl., iii., p. 35 (1816). *P. microcarpon* Fr., Symb. Gast., p. 23. *Didymium microcarpon* Rost., Mon., p. 157 (1875); Cooke, Myx. Brit., p. 32 ; Mass., Mon., p. 226 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 146. *Cionium xanthopus* Ditm., l.c., p. 37. *Didymium xanthopus* Fr., Syst. Myc., iii., p. 120. *D. pertusum* Berk., l.c., p. 313 ; Cooke, Myx. Brit., p. 35 ; Mass., Mon., p. 241. *D. proximum* Berk. & Curt., in Grev., ii., p. 52; Rost., Mon., App., p. 23 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 145 ; Mass., Mon., p. 238. *D. eximium* Peck, in Rep. N. York Mus., xxxi., p. 41; Mass., Mon., p. 241. *D. fulvellum* Mass., Mon., p. 237. *D. elegantissimum* Mass., Mon., p. 243.

a. **genuinum** : stalk and columella dark olive-brown.

β. **eximium** : stalk dark orange, columella orange or buff.—*D. eximium* Peck, *l.c.*

γ. **xanthopus** : stalk orange, columella white.—*D. xanthopus* Fr., *l.c.*

Plate XXXIX., B.—*a.* small and large sporangia of *a. genuinum*, × 20; *b.* sporangium of *γ. xanthopus*, × 20; *c.* sporangium of the same, broken and showing the white columella, × 20 ; *d.* capillitium and spores, with fragment of sporangium-wall, × 280 ; *e.* coarse capillitium (of less frequent occurrence), × 280 ; spore, × 600 (England).

Rostafinski's specific name, which he adopted from Fries, was given by this author as a MS. synonym of his *D. nigripes* in Symb. Gast., p. 23, and was never afterwards introduced into his works. Obviously Fries's name must be restored.

The above varieties have been distinguished by specific names, depending on the colour of the stalk, columella, and capillitium. The

capillitium may vary from white to purplish-brown in the same group of sporangia, and the colour of the stalk and columella is also inconstant. The specimen B. M. 885, from Ravenel, S. Carolina, has some sporangia with dark brown and others with deep orange stalks and columella on the same leaf, representing the forms *a* and *β*. *D. eximium* Peck and *D. fulvellum* Mass. have orange-red stalks, with the columella orange or pale buff. The type of *D. proximum* Berk. & Curt. (K. 1493) has also orange-red stalks and a buff columella. The type of *D. pertusum* Berk. (K. 463) has orange stalks and a white columella; it corresponds with the description of *D. xanthopus* of Fries in all essential characters, for the shape of the columella referred to by Berkeley is a varying feature. *D. elegantissimum* Mass. (K. 1) is the same variety. These forms blend into one another so completely that they are here united under *D. nigripes*.

Hab. On dead leaves.—*a.* Lynton, Devon (L:B.M.76); *a.* Lyme Regis, Dorset (L:B.M.76); *γ.* Batheaston, Somerset (B. M. 59, 101); *γ.* Edinbro' (K. 440); *a.* France (Paris Herb.); Germany, *a.* & *γ.* (Strassb. Herb.); *β.* (B. M. 436); *a.* Switzerland (B. M. 555); *γ.* Seychelles (Paris Herb.); Ceylon, *a.* (B. M. 561); *β.* (B. M. 559); *γ.* (B. M. 577); *γ.* Australia (B. M. 562); *β.* New Jersey (B. M. 566); *γ.* New York (B. M. 564); S. Caronila, *a.* & *β.* (B. M. 884, 885); *γ.* (B. M. 857); *a.* Brazil (K. 319); *a.* Chili (Strassb. Herb.).

7. **D. effusum** Link, Obs., ii., p. 42 (1816). Plasmodium greyish-white, among dead leaves. Total height 0·5 to 1 mm. Sporangia subglobose, or hemispherical, umbilicate beneath, stipitate, or sessile, or effused plasmodiocarps, gregarious, snow-white from abundant stellate crystals, which often form a wrinkled, deciduous, scaly, outer crust, or grey when the crystals are more scanty; in the plasmodiocarp forms the crystals are sparsely distributed; sporangium-wall membranous, sometimes mottled with red-brown towards the base. Stalk white, cylindrical, deeply furrowed, opaque and granular from deposits of lime, as long as the sporangium, or very short or wanting. Columella white, hemispherical; wanting in effused plasmodiocarps. Capillitium variable, of delicate or coarse threads, almost simple, or branching at an acute angle, usually with dark or pale calyciform thickenings; colourless, violet, or purplish-brown. Spores violet-brown spinulose, 8 to 11 *μ* diam.—Rost., Mon., p. 163; Mass., Mon., p. 236. *D. squamulosum* Fries, Symb. Gast., p. 19 (1818); Rost., Mon., p. 159; Cooke, Myx. Brit., p. 33; Mass., Mon., p. 223; Blytt, Bidr. K. Norg., Sop. iii., 1892, p. 6. *Diderma squamulosum* Alb. & Schw., Consp. Fung., p. 88 (1805). *Didymium leucopus* Fries, Syst. Myc., iii., p. 121. *D. costatum* Fries, l.c., p. 118. *D. confluens* Rost., Mon., App., p. 22. *D. macrospermum* Rost., Mon., p. 161; Mass., Mon., p. 228. *D. Fuckelianum* Rost., Mon., p. 161; Mass., Mon., p. 222. *D. præcox* de Bary, in Rab. Fung. Eur., No. 367; Rost., Mon., p. 163; Mass., Mon., p. 223. *D. radiatum* Berk. & Curt., in Journ. Linn. Soc., x., p. 348; Mass., Mon., p. 229 (in part). *Chondrioderma Alexandrowiczii* Rost., Mon., p. 169. *Didymium Alexandrowiczii* Mass., Mon., p. 232. *Chondrioderma Cookei* Rost., Mon., App., p. 17.

Physarum Tussilaginis Berk. & Br., in Ann. Mag. Nat. Hist., Ser. 4, xvii., p. 139. *Didymium Tussilaginis* Mass., Mon., p. 244.

Plate XL., A.—*a.* sporangia, stalked forms, × 20; *b.* sessile sporangia, one is broken and shows the white columella, × 20; *c.* plasmodiocarp form without columella, × 20; *d.* various forms of capillitium and spores, with fragment of sporangium-wall, × 280; *e.* spore, × 600 (England).

The varieties which occur in this common species have led to different forms receiving specific rank. Observations conducted for a length of time on large growths among one heap of leaves show that the colour of the capillitium varies from almost black to colourless in the same locality; a cluster on one leaf may present several shades, and even in a single sporangium one-half of the capillitium may be dark and the other half colourless; this difference of colour is seen in all forms, from the stalked sporangia to effused plasmodiocarps. The stalk and columella may vary from white to bright orange. The characters given as distinguishing *D. squamulosum*, *D. macrospermum*, *D. discoideum*, *D. præcox*, and *D. Fuckelianum* are so inconstant that they cannot be applied to mark even varieties of *D. effusum*. In the specimen of *D. effusum* Rost. (= *D. confluens* Rost., Mon., App., 22), in Strassb. Herb., the sporangia are stalked or sessile, with delicate white capillitium. In the sporangium examined the threads in one portion are without any thickenings; in the remaining part there are numerous small fusiform expansions apparently containing lime, as is not infrequent in this species; the spores are minutely spinulose. The specimen of *D. macrospermum* in Strassb. Herb. has colourless capillitium springing from a large white columella; the spores are strongly spinulose, 10 to 11 μ diam.; the size of the columella in *D. effusum* is very variable, and the large development in the Strassburg specimen of *D. macrospermum* is by no means exceptional; the roughness of the spores is the only feature which deviates from the usual forms of *D. effusum*, but as the spores of that species vary from nearly smooth to spinose in the same heap of leaves, and present all intermediate degrees of difference, this character cannot be taken as distinctive. *D. præcox* is described as having two walls; the type specimen at Strassburg is the frequent form of *D. effusum*, with the crust of crystals on the sporangium-wall wrinkled and scaly, but the wall itself is membranous and single. *D. discoideum* and *D. Fuckelianum* are given as distinguished by the coloured stalk, columella, and capillitium, and by the spotted sporangium-wall; these characters are met with in different degrees in sporangia of *D. effusum*, associated with those having white stalks and those with colourless walls and capillitium. The type of *D. radiatum* Berk. & Curt. (K. 1516) is nearly destroyed; only the stalks remain, but these are characteristic of *D. effusum*, being white and spreading at the base, deeply furrowed and granular with deposits of lime; Berkeley's description of the capillitium and spores is not at variance with frequent forms of this species. *Chondrioderma Alexandrowiczii* Rost., the type specimen of which is in the Strassburg Herb., is probably a form of *D. effusum*; the sporangia are sessile, with the capillitium and spores of that species; it differs from the type in the almost entire absence of lime. A specimen from Lyme Regis has the sporangium-wall similar to that of the Strassburg specimen; in both cases it is membranous with cloudy spots of brown, and with calcareous deposits in the form of scattered minute spicules; the capillitium in both is violet-brown, beset with short spines, and colourless at the extremities; the columella in both is represented by a brown thickening of the base without

lime deposits; the spores in the Strassburg specimen are minutely roughened with warts on the hemisphere of the usual number observed in *D. effusum*; the points of difference are that in the Strassburg specimen the sporangia are subglobose or of irregular shape, on a broad base, the sporangium-wall crumpled and whitish; in the Lyme Regis specimen the sporangium is a depressed plasmodiocarp, and resembles a *Lamproderma* in the iridescent wall; but it is associated with other sporangia scantily furnished with lime, and also with those of the usual form. *Chondrioderma Cookei* Rost., of which the gathering by Mr. Th. Brittain is represented in Strassb. Herb. and Brit. Mus. (B. M. 137), appears to be another form of *D. effusum*, differing from the type with sessile sporangia in the absence of lime except in minute spicules scattered over the sporangium-wall; the capillitium is an irregular network of dull violet threads, with expansions containing nodules of lime such as are of frequent occurrence in imperfect developments both in this species and its allies; the spores are spinulose, 10 to 12 μ diam.

Hab. On dead leaves, etc.; common.—Lyme Regis, Dorset (L:B.M. 77); Batheaston, Somerset (B. M. 37); Sydenham, Surrey (B. M. 1070); Welshpool, Montgomery (B. M.); France (K. 12); Germany (B. M. 530, 550); Austria (B. M. 567); Italy (B. M. 433); Ceylon (B. M. 456); New Zealand (K. 1324); Philadelphia (L:B.M.77); S. Carolina (K. 89); Cuba (K. 542); Chili (Paris Herb.); Paraguay (Paris Herb.).

8. **D. crustaceum** Fries, Syst. Myc., iii., p. 124 (1829). Plasmodium white, among dead leaves. Sporangia at first globose, confluent, aggregated or scattered, shortly stipitate or sessile, 0·7 to 2 mm. diam., smooth and white from the thick fragile deciduous crust of loosely compacted crystals of lime in which they are enclosed; when the crust has fallen away the sporangia are seen to be grey, and reniform or hemispherical; sporangium-wall membranous, colourless, clothed with large stellate crystals of lime. Stalks pale buff, 0·2 to 0·4 mm. high, membranous, eight or ten often clustered together on an expansion of the membranous hypothallus, at first concealed under the crust of lime enclosing the sporangia. Columella small, irregular, depressed, or not evident in the sessile forms, white or pale buff, charged with coarse granules of lime. Capillitium of colourless or pale violet branching threads 0·5 to 1 μ diam., with numerous minute fusiform thickenings. Spores purplish-grey, strongly spinulose, 10 to 13 μ diam. Rost., Mon., App., p. 22. *D. confluens* Rost., Mon., p. 164 (non Rost., Mon., App., p. 22); Mass., Mon., p. 235.

Plate XL., B.—*a*. sporangia, × 20; *b*. cluster of sporangia from which the outer crust of lime has fallen away, arising from a common hypothallus, × 20; *c*. capillitium and spores, × 280; *d*. crystals of lime from the sporangium-wall, × 280; *e*. spore, × 600 (England).

Closely allied to *D. effusum*, differing chiefly in the deciduous calcareous envelope of the sporangia, which is often 0·25 mm. thick, and in the membranous stalks. It forms a connecting link between *D. effusum* and *Spumaria alba*.

Hab. On dead leaves, etc.—Lyme Regis, Dorset (L:B.M.78); Poland (Strassb. Herb.).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

9. **D. fulvipes** Fries, Stirp. Femsj., p. 83. Stalks compressed, sulcate, orange-scarlet; sporangia globose, grey, villous; spores blackish.

Hab. On rotten birchwood.—Sweden.

Stalks and hypothallus, when present, as in *Trichia rubiformis*, 2 mm. or more in length; sporangia often confluent, blackish, but clothed with delicate grey down; columella none, flocci brown.

The description suggests a mouldy specimen, possibly of *Trichia Botrytis*.

10. **D. versipelle** Fries, Syst. Myc., iii., p. 117. Sporangia lenticular, umbilicate beneath, at first whitish-pruinose, then shining chestnut-brown; stalk conical, rugose, pale yellowish-red; columella brown; spores black.

Hab. On dead stalks, etc.; rare.—Sweden.

Stalk 2 mm. long, arising from a vein-like hypothallus; sporangium-wall membranous, at first pruinose, then naked and shining, opening by a longitudinal fissure; columella as in Schrader's figure of *D. tigrinum*, Nov. Gen. Pl., t. 6, fig. 3.

This description applies to *Lepidoderma tigrinum* Rost.

11. **D. dædalium** Berk. & Br., in Ann. Mag. Nat. Hist., Ser. 2, v., p. 366 (1850). Sporangia connate, labyrinthine-sinuous, pale brick-red, of the same colour as the short connate stalks, sprinkled with white meal; flocci white; spores purple-black, smooth, globose.

Hab. In great abundance in a cucumber frame.—Milton, Northts.

Spreading far and wide in little globose masses; stems reddish-brown, inclining to orange, connate, as if composed of little flat bran-like membranes, sporangia having a greyish tinge from the contained spores, which are purple-black; variegated with the white flocci, which are frequently forked, and vary greatly in width, being in parts flat, broad, and membranous.

This description of the connate sporangia, membranous stalks, and white capillitium applies to some forms of *Badhamia utricularis*, but the colour of the sporangia is against this determination.

12. **D. angulatum** Peck, in Rep. N. York Mus. Nat. His., xxxi., p. 41. Sporangia delicate, subglobose, whitish, clothed with minute granules and crystals of lime; stalk short, whitish; columella subglobose, pale yellowish; capillitium scanty, delicate, white, or slightly coloured; spores irregular, angular, black, 9 to 12 μ.

Hab. On dead leaves.—Adirondack Mts., N.Y.

This description applies to specimens of *D. effusum* in which the spores have shrunk.

13. **D. connatum** Peck, in Bull. Buffalo Soc. Nat. Sc., i., p. 64 (1874). Peridium depressed or subglobose, cinereous, furfuraceous,

stipitate; stems mostly connate at the base, tapering upwards, longitudinally wrinkled, white or cream-colour; spores subglobose, black, 10 μ diam.

Hab. On decaying fungi.—Portville, U.S.A.

This brief description would apply to connate forms of either *Physarum globuliferum* or *P. compressum* var. δ; but the shape of the sporangia is against its being reduced to *P. polymorphum*, as is done by Berlese (in Sacc. Syll., vii., p. 346).

14. **D. humile** Hazslinszky in Oester. Bot. Zeitschr., xxvii., p. 84 (1877). Sporangia applanate, grey, pruinose, slightly umbilicate above, deeply beneath; stalk cylindrical, short, brown; capillitium brown, of smooth, simple, flexuose threads; spores brown, 6 to 7 μ.

Hab. Hungary.

This description applies to *D. farinaceum* var. *minus*.

15. **D. platypus** Hazslinszky, *l.c.*, p. 83 (1877). Sporangia greyish-white, pruinose, scattered, convex above, deeply umbilicate beneath; stalk cylindrical, dilated into a disc at the apex; columella none; capillitium scanty, consisting of black threads combined into a net; spores blackish, smooth, 8 μ diam.

Hab. On rotten stalks.—Hungary.

16. **D. affine** Raunk., in Bot. Tidsskrift, xvii., p. 88, t. v., figs. 3 and 4. Sporangia spherical-hemispherical, stipitate. Stem thin, of equal length or longer than the sporangium, expanded into a circular hypothallus at the base, light brown; wall grey under the microscope, after the lime has fallen away colourless. Columella globose or semi-globose, the colour of the stem, or lighter. Threads of the capillitium nearly hyaline, expanded into numerous shortly fusiform, brownish-violet swellings. Spores smooth or delicately warted, 8 to 9 μ diam.

Hab. On germinating seeds.—Copenhagen.

This description applies to pale brown stalked forms of *D. effusum*.

17. **D. longipes** Mass., Mon., p. 236, fig. 226. Sporangia small, globose, snow-white, frosted with a few scattered granules or crystals of lime; stem very long and slender, erect, snow-white, very slightly attenuated upwards, almost smooth, expanding at the base with a small circular white hypothallus; columella absent; capillitium well developed, threads very thin, colourless, branching and anastomosing irregularly to form a network, nodes usually triangular; spores globose, dingy lilac, smooth, 8 to 10 μ diam.

Hab. On bark and wood.—Britain (Yorks); South Carolina.

There is no specimen in Kew Herb. under this name as cited by Mr. Massee.

The following species are excluded by Rostafinski for what appear to be sufficient reasons (see Rost., Mon., p. 229-301):—

D. Linkii Fr.
D. muscicola Link.
D. nanum Fr. & Wein.
D. parietinum Schrad.
D. plicatum Corda.
D. Weinmannii Fr.

D. Sowerbyi Berk., in Sm. Eng. Flora, Fungi, p. 313, must also be excluded, as the description is too imperfect to determine what it is.

SPECIES EXCLUDED FROM THE GENUS.

D. australis Mass.	= *Trichamphora pezizoidea* Jungh.
D. Barteri Mass.	= *Physarum globuliferum* Pers.
D. echinospora Mass.	= *Physarum compressum* A. & S.
D. erythrinum Berk. & Curt.	= *Physarum pulchripes* Peck.
D. flavicomum Mass.	= *Physarum Berkeleyi* Rost.
D. granuliferum Phill.	= See note after *Lepidoderma Carestianum* Rost.
D. obrusseum Berk. & Curt.	= *Physarum polymorphum* Rost.
D. paraguayense Speg.	= *Craterium rubescens* Rex.
D. pezizoideum Mass.	= *Trichamphora pezizoidea* Jungh.
D. sinapinum Cooke.	= *Physarum virescens* Ditm.
D. spumarioides Fr.	= *Chondrioderma spumarioides* Rost.
D. tenerrimum Berk. & Curt.	= *Physarum polymorphum* Rost.
D. Zeylanicum Berk. & Br.	= *Trichamphora pezizoidea* Jungh.

Genus 13.—**SPUMARIA** Persoon, Obs. Myc., i., p. 92 (1796). The sporangia are confluent to form an æthalium, otherwise the characters are those of the genus *Didymium*.

1. **S. alba** DC., Fl. Fr., ii., p. 261 (1805). Plasmodium opaque-white, among grass and dead leaves. Æthalia composed of elongated, compressed and folded, lobed and confluent, grey sporangia, arising in more or less loosely compacted clusters from branching processes of the membranous hypothallus, clothed with a thick but fragile and deciduous, white, universal covering of crystals of lime; 2 to 4 c.m. long, 1 to 2 c.m. wide, and about 1 c.m. thick. Sporangium-wall membranous, purplish or colourless. Columella membranous, hollow, compressed, following in its branches the form of the confluent sporangia, sometimes absent. Capillitium a network of widely branching, anastomosing, stout, purplish-brown threads, with numerous dark calyciform thickenings, hyaline at the extremities where they are attached to the sporangium-wall or columella; these are accompanied occasionally with tubular processes of the sporangium-wall, open externally, and either completely perforating the flattened lobes

of the sporangia or continued into the capillitium threads. Spores dull purple, strongly spinulous, 10 to 13 μ diam.—Rost., Mon., p. 191; Cooke, Myx. Brit., p. 45; Blytt., Bidr. K. Norg., Sop. iii. (1892), p. 7; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 144. *Reticularia alba* Bull., Champ., p. 92, t. 326 (1791).

Plate XLI., A.—*a.* æthalium, × 2; *b.* cluster of sporangia from an æthalium; in three places they are broken and show the hollow columellæ, × 20; *c.* capillitium and spores, × 280; *d.* crystals from the investing covering of lime, × 280; *e.* spore, × 600 (England).

Allied to *Didymium* through *D. crustaceum*, but separated by its æthalial habit.

Hab. On grass, dead leaves, etc. Common in Europe. Highgate, Middlesex (B. M. 161); Batheaston, Somerset (B. M. 171); Oxfordshire (B. M. 1083, 1084, 1085); Cromarty, Scotland (B. M. 1088); Ireland (K. 584); France (B. M. 997); Belgium (B. M. 594); Germany (B. M. 599); Finland (B. M. 597); Poland (Strassb. Herb.), Ohio (L:B.M.79); Iowa (L:B.M.79).

The description of *Spumaria Micheneri* Berk., in Grev., vol. ii., p. 52, is too brief in the absence of the type to be of value.

Genus 14.—**LEPIDODERMA** de Bary, in Rost., Versuch, p. 13 (1873). Sporangia stalked, sessile, or plasmodiocarps; sporangium-wall cartilaginous, beset with superficial crystalline scales; capillitium profuse, without lime.

KEY TO THE SPECIES OF *LEPIDODERMA*.

Sporangia subglobose	*L. tigrinum.*
Sporangia forming plasmodiocarps .	*L. Carestianum.*

1. **L. tigrinum** Rost., Versuch., p. 13 (1873).—Plasmodium yellow (*teste* Schrœter). Sporangia subglobose, flattened and umbilicate beneath, stipitate or sessile, scattered, 1 to 1·5 mm. diam., olive- or purplish-grey, glossy, more or less closely beset with rounded or angular crystalline scales of lime, which are sometimes wanting; sporangium-wall cartilaginous, of two closely combined layers, orange-yellow. Stalk stout, cylindrical 0·2 to 0·4 mm. thick, furrowed, orange-brown, of a spongy texture within, containing deposits of lime; rising from a hypothallus which is either vein-like, or effused and of a loose reticulated structure. Columella hemispherical, brown, of the same texture as the stalk, containing deposits of lime in rounded nodules. Capillitium profuse, of straight or flexuose threads, sparingly branched, dark purple-brown or grey. Spores dark purplish-grey, minutely and closely spinulose, 8 to 13 μ diam.—Mon., p. 187; Cooke, Myx. Brit., p. 44; Blytt, Bidr. K. Norg., Sop. iii., 1892, p. 7; Mass., Mon., p. 253. *Didymium tigrinum* Schrad., Nov. Gen. Pl., p. 22 (1797). *Lepidoderma fulvum* Mass., Mon., p. 253.

Plate XLI., B.—*a.* sporangium, × 20; *b.* fragment of sporangium-wall with crystalline discs, × 50; *c.* capillitium and spores, × 280; *d.* spore. × 600 (Germany).

The specimen from Ceylon, named by Berkeley *Didymium leoninum* (K. 1554), which is given by Rostafinski as a synonym for *L. tigrinum* (Mon., App., p. 23), is immature, the capillitium and spores being undeveloped ; the deposits of lime on the cartilaginous, orange sporangium-wall are in the form of large stellate crystals ; those in the spongy tissue of the columella are in rounded masses as in typical *L. tigrinum*. The type specimens of *L. fulvum* Mass., from Scarboro' (Herb. Mass.), and from Belle Croix, France (K. 1555 ; Paris Herb.), are immature specimens of *L. tigrinum*; the spores appear warted under a high magnifying power, though the warts are faint from their unripe condition ; the French specimen is part of the large gathering by Roussel, given as a type of *L. tigrinum* by Rostafinski (Mon., p. 188). Growing with stalked specimens of *L. tigrinum*, Prof. Farlow has twice found, in Massachusetts, sporangia of a sessile, depressed form, with capillitium and spores exactly as in the type, but with the sporangium-wall of two layers, the outer delicate, ochraceous, densely charged with irregular granules of lime, separating more or less from the inner layer, which is yellow and membranous above, orange and cartilaginous towards the base ; the columella is small and depressed. Taken by itself this form would be a *Chondrioderma*, but considering its association with sporangia of *L. tigrinum*, from which it differs only in shape, and the granular, not crystalline, condition of the lime on the sporangium-wall, it appears that it is a form of this species.

Hab. On bark, moss, etc.—Leighton, Beds (L:B.M.80) ; Inverary, Scotland (K. 568) ; France (K. 1555) ; Denmark (K. 1557) ; Germany and Italy (Strassburg) ; Ceylon (K. 1554) ; Mass., U.S.A. (L:B.M.80) ; S. Carolina (Paris).

2. **L. Carestianum** Rost., Mon., p. 188 (1875). Plasmodium? Sporangia forming elongate, pulvinate plasmodiocarps, 10 to 15 mm. long, 1 mm. thick, brownish-grey, closely beset with white crystalline scales of lime; sporangium-wall cartilaginous, dark brown. Columella hardly evident, represented by the thickened dark brown base of the sporangium-wall, enclosing rounded nodules of lime. Capillitium of colourless, and pale-brown, branching and anastomosing threads, 2 μ thick. Spores dark purplish-grey, minutely spinulose, 12 to 18 μ diam.—Mass., Mon., p. 255. *Reticularia Carestiana* Rabenh., Fung. Eur., No. 436 (1862).

Plate XLI., B.—*e.* part of plasmodiocarp, × 20 ; *f.* capillitium and spores, × 280 (Italy).

This species appears to be represented by a single gathering, and would seem to be a plasmodiocarp form of L. *tigrinum*.

Hab. On twigs.—Carestia, North Italy (B. M. 578).

The type specimen of *Didymium granuliferum* Phillips (*Badhamia granulifera* Mass., Mon., p. 321) from Dr. Harkness, Blue Cañon, California (L:B.M.78), has the sporangia subglobose or extended, somewhat depressed, sessile on a broad base, 2 to 3 mm. long, gregarious on an effused hypothallus, which, together with the sporangia, is pale brown, and thickly studded with crystalline scales; the sporangium-wall is of two layers, the outer cartilaginous, pale-brown, with deposits of lime in the form of closely set, angular, crystalline

nodules, separating more or less from the membranous, pale-brown inner layer. The columella is hemispherical or hardly evident, brown, of spongy texture within, densely charged with rounded nodules of lime; the capillitium is a network of pale-brown, hyaline threads, with numerous wide membranous expansions, containing scanty deposits of lime in the form of rounded nodules 20 to 30 μ diam.; the spores are purplish-black, closely spinulose, 15 to 30 μ diam. The cartilaginous sporangium-wall, with its crystalline deposits of lime and the structure of the columella, appears to mark this species, which is represented by a solitary gathering, as a *Lepidoderma*. Although lime does not occur in well-developed capillitium of the *Didymiaceæ*, it is occasionally found in nodular deposits in the threads of *Didymium squamulosum* and *D. farinaceum*. It is possible, from its presence in the capillitium of Dr. Harkness' gathering, that this is not a perfect development, and this view is supported by the great variety in the size of the spores.

Plate XLII., A.—*a*. sporangia, × 20; *b*. capillitium and spores, with fragment of sporangium-wall, × 280 (California).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

3. **L. Chailletii** Rost., Mon., p. 189, fig. 179. Sporangia hemispherical, adnate on a broad base to the hypothallus or substratum, violet-black, covered with many pearl-like, brown protuberances; columella small, brownish-ochre; capillitium of dull-violet threads forming a dense net; spores dull violet, warted, 10·8 to 12·5 μ diam.

Hab. Switzerland (Chaillet); Hammerstein (Opiz). The columella is composed of fibres forming numerous false chambers filled with crystalline nodules of lime.

This description applies to a sessile form of *L. tigrinum*.

4. **L. obovatum** Mass., Mon., p. 254. Sporangia broadly obovate, stipitate; wall dirty ochraceous, thick, studded with large innate patches of lime; stem short, thick, dark brown, wrinkled; columella none; threads of capillitium 3 to 4 μ thick, dingy violet, branching dichotomously with a swelling at the base of each branch, the whole combined into an irregular net; spores dingy violet, minutely warted, 11 to 13 μ diam.

Hab. On grass and twigs.—Sweden; Kew Herb.

I have seen no specimen thus named in Kew Herb. The figures (45—47) are given by Massee in the text of his Monograph as representing this species, but they refer to other species for which they are elsewhere quoted.

The description of *L. Kurzii* Berk. (Mass., Mon., p. 255), taken from the MS. in Berkeley's Herb., has no mention made of the capillitium, and is too brief to be instructive.

SPECIES EXCLUDED FROM THE GENUS.

L. reticulatum Mass. = *Badhamia decipiens* Berk.

L. stellatum Mass. = *Physarum compactum* List.

Subcohort II.—*AMAUROCHÆTINEÆ*. Sporangia single, or combined into an æthalium, without deposits of lime; capillitium and spores dark-brown or violet-brown, rarely pale.

Order I.—STEMONITACEÆ. Sporangia stipitate; sporangium-wall a simple delicate membrane, often evanescent; stalk extending within the sporangium as a columella from which the branching threads of the capillitium take their origin.

KEY TO THE GENERA OF *STEMONITACEÆ*.

Sporangium-wall evanescent. Capillitium springing from all parts of the elongated columella, ultimate branchlets united to form a superficial net. (15) STEMONITIS.

Fig. 23.—*Stemonitis splendens* Rost.

a. Group of sporangia. Natural size.

b. Portion of capillitium and columella. Magnified 42 times.

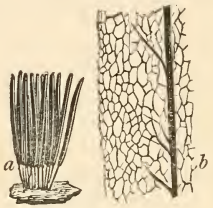

Fig. 23.

Sporangium-wall evanescent. Capillitium as in *Stemonitis*, but not forming a superficial net, or only imperfectly towards the base of the sporangium. (16) COMATRICHA.

Fig. 24.—*Comatricha obtusata* Preuss.

a. Group of sporangia. Natural size.

b. Sporangium deprived of spores showing the capillitium. Magnified 16 times.

Fig. 24.

Sporangium-wall evanescent. Columella reaching to the apex of the sporangium, capillitium springing from beneath the superficially expanded end of the columella. (17) ENERTHENEMA.

Fig. 25.—*Enerthenema elegans* Bowm.

a. Group of sporangia. Twice the natural size.

b. Sporangium. Magnified 16 times.

c. Sporangium deprived of spores, showing the capillitium. Magnified 16 times.

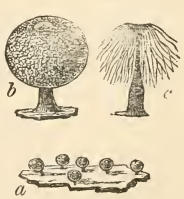

Fig. 25.

Sporangium-wall somewhat persistent, columella about half the height of the sporangium. (18) LAMPRODERMA.

Fig. 26.

Fig. 26.—*Lamproderma irideum* Mass.

a. Group of sporangia. Magnified 2½ times.

b. Sporangium deprived of spores, showing capillitium. Magnified 25 times.

Sporangium-wall partly evanescent, persistent in the form of minute discs at the apex of the rigid capillitium threads. Columella short or hardly evident. (19) CLASTODERMA.

Fig. 27.

Fig. 27.—*Clastoderma Debaryanum* Blytt.

a. Group of sporangia. Magnified 10 times.

b. Sporangia deprived of spores, showing capillitium. Magnified 64 times.

Genus 15.—**STEMONITIS** Gleditsch, Meth. Fung., p. 140, tab. iv. (1753). Sporangia cylindrical, stipitate, fasciculate; the stalk extending within the sporangium to near the apex as a columella; capillitium formed of numerous threads radiating from all parts of the columella and combined into a loose net-work, the ultimate branches united into a superficial net attached to the evanescent sporangium-wall.

KEY TO THE SPECIES OF *STEMONITIS*.

A. Spores grey, violet-grey, or rufous-violet :—

a. Spores spinulose, more or less reticulated, surface net of capillitium with angular meshes. 1. *S. fusca*

b. Spores minutely warted, almost smooth, surface net of capillitium with usually rounded meshes—

Meshes of surface net of capillitium 20 to 100 μ or more wide; sporangia forming on wood. 2. *S. splendens*

Meshes of surface net of capillitium less than 20 μ wide; sporangia forming on herbaceous plants. 3. *S. herbatica*

B. Spores pale ferruginous :—

Spores 7 to 9 μ diam., plasmodium yellow.
4. *S. ferruginea.*

Spores 4 to 6 μ diam., plasmodium white.
5. *S. Smithii.*

1. **S. fusca** Roth, in Röm. & Ust. Mag. Bot., i., pt. 2, p. 26 (1787). Plasmodium white, in rotten wood, maturing at the place of emergence. Total height, 2 to 5 mm. Sporangia cylindrical, obtuse, stipitate, purplish-black, at first closely fasciculate. Stalk black, shining, 1 to 4 mm. long, 0·3 to 0·7 mm. thick, rising from a well-developed, brown, membranous hypothallus. Columella reaching to near the apex of the sporangium. Capillitium of dark brown threads springing from all parts of the columella, combined into a loose network, the ultimate branches forming a delicate superficial net, with angular, unequal meshes varying from 6 to 16 μ wide. Spores grey or rufous-violet, spinulose, with more or less reticulated sculpture, 6 to 10 μ diam.—Rost., Mon., p. 193 ; Cooke, Myx. Brit., p. 46 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 8 ; Mass., Mon., p. 72 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 141. *S. maxima* Schweinitz, in Trans. Am. Phil. Soc. (1834), p. 260 ; Macbride, *l.c.*, p. 141. *S. dictyospora* Rost., Mon., p. 195 ; Mass., Mon., p. 83. *S. nigrescens* Rex, in Proc. Acad. Nat. Soc. Phil. (1891), p. 392. *S. Castillensis* Macbride, *l.c.*, ii., p. 381, Plate X., fig. 5. *Amaurochæte speciosa* Zukal, Verh. Zool.-Bot. Gesell. Wien, xxxv., p. 335, t. 15, f. 8.

α. **genuina** : spores grey or violet-grey, reticulated, 8 to 10 μ diam.

β. **rufescens** : spores rufous-grey, faintly reticulated, 6 to 8 μ diam.

γ. **confluens** : sporangia confluent, lobed, without stalk, columella, or superficial net.

Plate XLII., B.—*a.*, *b.* sporangia, *a. genuina*, × 2 ; *c.* capillitium, × 180 ; *d.* sporangia *β. rufescens*, × 2 ; *e.* capillitium, *γ. confluens*, × 180 ; *f.* spore, *a. genuina*, × 600 ; *g.* spore, *β. rufescens*, × 600 ; *h.* three spores from one sporangium uniting the characters of *α.* and *β.*, × 600 (England) ; *i.* three spores from one sporangium (England) ; *k.* spore of *S. trechispora* Berk., × 600 (Venezuela).

Plate LXXVII., A.—*a.* pendulous æthalium, *γ. confluens*, × 20 ; *b.* pulvinate æthalium, × 3 ; *c.* capillitium of same attached to a fragment of sporangium-wall, × 180 ; *d.* spores, × 600 (Epping Forest, England).

The spores of this very abundant species are never smooth, and when magnified 1,200 diam. present the following modifications in sculpture ; in *a.* this either consists of spines, thickened and connected at their bases, forming a complete net with from 20 to 50 meshes on the surface of the hemisphere, and giving a continuous border to the spore ; or the spines are less connected, forming a broken net, and giving an irregular border to the spore ; or the spines are distinct, arranged on a more or less reticulate plan, giving a spinulose margin to the spore. In *β.* the sculpture is usually less pronounced, but the

minute spines are arranged in the same manner as in *α.*, either giving a close or open reticulation on the surface of the spore or grouped more or less in clusters (not evenly distributed as in the faintly warted spores of *S. splendens*). These two varieties represent well-marked centres, but there is no definite boundary between them denoting a true specific difference ; sporangia widely differing in length and with long or short stalks may have spores of either form ; *γ.* occurs with both large and small spores. Rostafinski's types of *S. fusca* from Vera Cruz (B. M. 631) and from Ruda Guzowska (Strassb. Herb.) have the spores not smooth, as he describes, but of a form intermediate between *α.* and *β.*, 7 to 8 *μ* diam., with about 28 meshes of reticulation on the hemisphere. *S. dictyospora* Rost. appears to be an unnecessary name ; it is represented in Kew Herb. by the two types referred to in Rost., Mon., App., p. 27 ; one from Ceylon (K. 1622) bearing the signature of Rostafinski is *S. fusca β.* and has small spores 5 to 6·5 *μ* diam., reticulated in the same manner as in the Strassburg type of *S. fusca*, but more faintly ; the other type is from Venezuela (K. 1620, B. M. 648) on a palm leaf, and in poor condition ; it was marked by Berkeley *S. trechispora ;* the spores are 10 to 12 *μ* diam., with a strong complete reticulation in the form of raised bands giving an even border to the spore 1 *μ* broad. These examples might be taken as representing the extreme limits in size and reticulation of the spores of *S. fusca*. The specimen from Venezuela, however, differs so considerably from its nearest allies in the strong and banded reticulation of the spores, that it is a question whether it might not be retained for the present as a distinct species under Berkeley's name of *S. trechispora*. A type specimen of *S. maxima* Schwein. received from Dr. Rex of Philadelphia (2697, N. American Fungi, Ellis and Everhart, L:B.M.82), has the spores 7 *μ* diam., with reticulation precisely of the form above described in Rostafinski's type of *S. fusca* in Strassb. Herb. The type of *S. nigrescens* Rex, kindly furnished by Dr. Rex, has dark spores as in *α.*, but only 7 *μ* diam. *S. Castillensis* Macbride, from Nicaragua (B. M. 1002) presents no characters by which it can be separated from *S. fusca β.* ; the spores are distinctly reticulated, and measure 6 to 7 *μ*. The confluent form of the sporangia is in some cases seen throughout the whole development from one plasmodium, the capillitium consisting of a profuse network of arching threads, with broad expansions at the nodes, but sometimes only a part presents the confluent form, and is associated with more or less perfect sporangia with the normal superficial net. An exceptional form of *γ. confluens* is figured in Plate LXXVII. (L:B.M.82) ; it was found in Epping Forest developing from white plasmodium on dead leaves near rotten wood. The sporangia are combined into a convolute æthalioid mass, the membranous sporangium-walls are to a great extent persistent ; no stalks are developed, but in one case the whole æthalium is suspended by a long slender thread of hypothallus ; the columellæ are wanting, and the capillitium is represented by a scanty network of irregular threads with many wide expansions, attached at the extremities to the sporangium - walls. The spores are perfectly formed, 6 *μ* diam., minutely warted, with the warts here and there connected by faint lines suggesting the appearance of a reticulation. This development is interesting as showing to what extent variation may occur ; if it were not connected with the type with intermediate forms, the position of the specimen might be difficult to determine. The description and figure of *Amaurochæte speciosa* Zukal (*l.c.*) leave little doubt that his species is the form *γ* of *S. fusca.*

Hab. On dead leaves, wood.—*a*, *β*, *γ*. Leytonstone, Essex (L:B.M.82); *a*, *β*, *γ*. Lyme Regis, Dorset (L:B.M.82); *β*. Batheaston, Somerset (B. M. 208); *γ*. Edinburgh (K. 796); *a*. and *β*. France (Paris Herb.); Germany, *a*. (B. M. 623); *γ* (B. M. 650); *a*. Austria (B. M. 626); *a*. Italy (B. M. 621); *β*. Poland (Strassb. Herb.); *β*. Russia (Paris Herb.); *β*. Ceylon (K. 1622); *a*. and *β*. Java (K. 1591); *β*. Australia (B. M. 635); *β*. New Zealand (K. 666); *β*. New Caledonia (Paris Herb.); *a*. Tonga (L:B.M.82); *a*. Philadelphia (L:B.M.82); *β*. Iowa (L:B.M. 82); *β*. Texas (B. M. 919); *β*. Nicaragua (B. M. 1002); *a*. French Guiana (Paris Herb.); *β*. Vera Cruz (B. M. 631); *β*. Para, Brazil (K. 686); Venezuela (*Stemonitis trechispora*), (B. M. 648).

2. **S. splendens** Rost., Mon., p. 195 (1875). Plasmodium creamy white, on fir stumps, etc., maturing at the place of emergence. Total height 6 to 12 mm. Sporangia cylindrical, obtuse, stipitate, purplish-brown, at first closely fasciculate. Stalk black, shining, slender, 1 to 4 mm. long, rising from a well-developed silvery or purplish hypothallus. Columella reaching to near the apex of the sporangium, rigid, sometimes weak and flexuose in the upper half. Capillitium of purplish-brown threads, the principal branches varying in intricacy, but usually springing at distant intervals from the columella, at first almost simple, suddenly branching to form a superficial net with smooth, rounded, variously shaped meshes, 20—100 μ wide. Spores pale reddish-purple, nearly smooth, or minutely and closely warted, 7 to 9 μ diam.—*Stemonitis Morgani* Peck, in Bot. Gaz., v., p. 33; Mass., Mon., p. 86; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 142. *S. maxima* Mass. (non Schwein.), Mon., p. 74. *S. Bauerlinii* Mass., Mon., p. 79; Rex, in Proc. Acad. Nat. Sc. Phil. (1890), p. 36. *S. Webberi* Rex, *l.c.* (1891), p. 390. *S. acuminata* Mass., Mon., p. 78. *S. confluens* Cke. & Ellis in Grev., v., p. 51; Mass., Mon., p. 77.

a. **genuina**: superficial net of capillitium complete, with rounded meshes, 20 to 70 μ diam.

β. **Webberi**: sporangia stiff, erect; superficial net complete, with meshes 80 to 100 μ wide.

γ. **flaccida**: sporangia weak, adhering; capillitium lax, scarcely forming a superficial net; membranous flakes of sporangium-wall always present.

δ. **confluens**: sporangia confluent, without superficial net.

Plate XLIII., A.—*a*, *b*, *c*, sporangia, *a*. *genuina*, × 2; *d*. capillitium of Rostafinski's type from Texas, × 180; *e*. capillitium with membranous expansion, from Rostafinski's type (Cuba), × 180; *f*. capillitium of type of *S. Morgani* Peck, × 180; *g*. sporangia, *γ*. *flaccida*, × 2; *h*. capillitium of the same, with membranous expansion, × 180 (England); *i*. spore, × 600.

Var. *δ*. corresponds with the confluent form of *S. fusca*; the capillitium forms a dense intricate network, connected with indefinite branching columellæ, with frequent membranous saucer-shaped expansions, without stalks or superficial net. The specimen from N. Carolina (Curtis, 419), named *Lachnobolus cribrosus* (B. M. 935) appears to be this variety, and the note by Fries following his description of

L. cribrosus (Syst. Myc., iii., p. 87) implies that he probably had the confluent form of a *Stemonitis* before him. *S. confluens* Cke. & Ellis, from New Jersey, Ellis (K. 665 ; and L:B.M.83, part of the same gathering, furnished by Dr. Rex), appears also to be a confluent form of *S. splendens* ; the spores in both the N. Carolina and New Jersey specimens have the typical sculpture, but are darker than usual, and measure 9 to 10 μ diam. A specimen from Meudon in the collection of the Paris Museum closely resembles that from New Jersey in the character of the capillitium ; the spores have also the same dark tint, and measure 10 to 11 μ ; but the sporangia are more normal, having in some cases a simple columella and a nearly complete superficial net with a wide mesh. Only three or four European gatherings of this species are represented in the Strassburg, Brit. Mus., and Kew Collections; it is plentiful in India, America, Australia, and the Pacific Islands, from which regions there are numerous specimens in the collections, which were classed under *S. fusca*, until Rostafinski detected the specific characters and gave the name of *S. splendens*. The capillitium in this species exhibits wide differences, but the spores are remarkably constant in colour, size, and in the minute, evenly distributed warts, which are sometimes scarcely apparent, even when magnified 1,200 diam. ; their distribution resembles that on the spores of *Physarum nutans*. The superficial net of the capillitium appears to be continuous with the evanescent sporangium-wall, which is not merely attached by short spines projecting from the net as in *S. fusca* ; this character is illustrated by a remarkable form described by Dr. Rex (Proc. Acad. Nat. Sc. Phil., 1890, p. 36) under the name *S. Bauerlinii* Mass., *f. fenestrata*. He records the appearance of successive growths of the *Stemonitis* at considerable intervals of time, on a limited area of a decaying log, apparently from one original source. Through the courtesy of Dr. Rex the gatherings are represented in the mountings in the Brit. Mus. In mounting (*a*) the sporangium-wall is persistent except in approximate circular perforations 10 to 20 μ wide, or in other words the superficial net is expanded to form a perforated wall to the sporangium. Mounting (*b*) is from a later gathering, with much of the character of (*a*), but approaching nearer to the normal form. Mounting (*c*) is from a crop appearing a month later than (*b*), in which there is a still more marked return to the usual habit, with the meshes of the net 30 to 60 μ wide. The width of the mesh varies in Rostafinski's types from Cuba and Texas (referred to Rost., App., p. 27) ; in that from Cuba (B. M. 630) the average width of the mesh is 70 μ, in that from Texas (K. 1631) it is 20 μ. *S. Morgani* Peck, N. Am. Fungi, Ellis & Everh. 2088, and *S. Bauerlinii* Mass., from New Guinea (K. 726), are essentially the same form as the Cuba type, the mesh of the superficial net averaging about 60 μ in width, *S. Webberi* Rex (*f. β*) has a wider mesh than the Cuba type, and is described (*l.c.* 1891, p. 391) as distinguished from *S. splendens* by the spores being ferruginous-coloured in mass, and by the pale surface capillitium; the mounted specimens do not show this difference of colour. The form gathered at Lyme Regis in 1891 (Journ. Bot. 1891, p. 263), var. γ, has even more lax and broken capillitium than var. β, and the spores in mass are rich purple-brown ; the growth has appeared on the same fir stumps in abundance in 1892 and 1893, with much the same characters as in the first gathering. It has also been obtained from the New Forest, Hants, from the Black Forest near Freiburg, and from Ohio. The type specimen of *S. acuminata* Mass. (K. 698) is *a. genuina*, the spores measuring 7 to 8 μ diam. In looking through

a large series of specimens of this group there is a general character which runs through them all in the constant type of the spores and in the smooth purple-brown capillitium, which points to the conclusion that however widely the size of the mesh of the surface-net may vary, they are all forms of one species.

Hab. On dead wood.—γ. Lyme Regis, Dorset (L:B.M.83); δ. Meudon, France (Paris Herb.); *a.* Germany (B. M. 619); γ. Black Forest (L:B.M.83); *a.* Italy (B. M. 999); *a.* Natal (K. 694); *a.* Australia (K. 716); *a.* New Zealand (K. 688); *a.* Isle of Pines, New Caledonia (B. M. 1093); *a.* Samoa (L:B.M.83); *a.* Iowa (B. M. 820); δ. New Jersey (L:B.M.83); β. and γ. Ohio (L:B.M.83); *a.* S. Carolina (B. M. 918); *a.* Darien (B. M. 916); *a.* Cuba (B. M. 630); *a.* French Guiana (Paris Herb.); *a.* Brazil (B. M. 1089).

3. **S. herbatica** Peck, in Rep. N. York Mus., xxvi., p. 75 (1874). Plasmodium? Sporangia cylindrical, in densely fasciculated clusters, 5 to 7 mm. high, red-brown. Stalk 0·8 mm. high, arising from a membranous hypothallus. Capillitium of dark brown threads, springing from the columella and forming a very loose network, uniting at the surface into a net with rounded meshes, 7 to 17 μ diam. Spores pale reddish-purple, minutely spinulose, 6 to 9 μ diam.—Mass., Mon., p. 87.

Plate XLIII., B.—*a.* sporangia on leaf, × 2 (Java, leg. Zollinger); *b.* capillitium of same, × 170; *c.* sporangia, Peck's type, × 2 (U.S.A.); *d.* capillitium of same, × 170; *e.* sporangia on leaf, natural size (Rangoon); *f.* sporangia, × 2; *g.* capillitium of same, × 170; *h.* spore, × 600.

The above description is made from Peck's type, kindly furnished by Dr. Rex. The species is allied to *S. ferruginea* and to *S. splendens*, having the capillitium, and the habit of fruiting on herbaceous stems, of the former, and the purplish spores of the latter. It holds an intermediate position, different gatherings showing a tendency towards one or the other of its allies; but it is a useful centre under which to place forms possessing a distinct general character which were difficult to locate before Peck gave them a specific rank. It does not appear in the collections as a British species, and European gatherings are not frequent. The specimen figured from Java was given by Rostafinski as a type of *S. fusca*, from which it is distinguished by the nearly smooth spores and wandering habit of the plasmodium. Peck's type is nearly identical with the Java specimen (see Pl. XLIII., B., *c* and *d*.).

Hab. On leaves, etc.—France (K. 706); Germany (Strassb. Herb. as *Stemonitis fusca* var. *minor leiosperma* de Bary); Switzerland (K. 1606); Pondicherry, India (B. M. 84); Ceylon (K. 1624); Rangoon (K. 1612); Java (B. M. 1091); Borneo (L:B.M.84); Australia (K. 711); New York (L:B.M.84); Carolina (K. 1581); S. Domingo (B. M. 640).

4. **S. ferruginea** Ehrenb., Sylv. Myc. Berol., p. 25 (1818). Plasmodium citron-yellow, in rotten wood, usually creeping from the place of emergence, and maturing on surrounding herbage. Total height 5 to 7 mm. Sporangia cylindrical, obtuse, in closely fasciculate clusters, stipitate or nearly sessile, cinnamon-brown. Stalk black, 0·5 to 1·5 mm. high. Columella often reaching the apex of the sporangium and expanding as a funnel-shaped membranous cap, or ceasing far below the summit,

Capillitium of ferruginous or brown threads, springing from the columella, and forming a loose network with numerous broad membranous expansions; meshes of the delicate, superficial net, angular, varying from 6 to 16 μ diam. Spores pale ferruginous, faintly warted, 6 to 9 μ diam.—Rost., Mon., p. 196 (in part); Cooke, Myx. Brit., p. 46 (in part); Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 9; Mass., Mon., p. 85 (in part).

Plate XLIV., A.—*a*. sporangia, × 2; *b*. capillitium, × 180; *c*. capillitium and columella expanded to form a membranous cap at the apex of the sporangium, × 180; *d*. spore, × 600 (England).

Hab. On leaves and dead wood.—Lyme Regis, Dorset (L:B.M.85); Leighwood, Somerset (B. M. 206); Hartham, Wilts (B. M. 210); France (Paris Herb.); Germany (K. 778); Freiburg (Strassb. Herb.); Hungary (K. 1616).

5. **S. Smithii** Macbride, in Bull. Nat. Hist. Iowa, ii., p. 381, fig. 4 (1893). Plasmodium white. Total height 7 to 12 mm. Sporangia cylindrical, densely fasciculate, stipitate, cinnamon-brown. Stalk black, 3 to 6 mm. long, arising from a membranous hypothallus. Columella ceasing below the apex of the sporangium. Capillitium as in *S. ferruginea*, but the superficial net has rounded, more regular meshes, 5 to 10 μ diam., and the threads of the meshes are often rather stout. Spores pale ferruginous, nearly smooth, 4 to 6 μ diam. *Stemonitis ferruginea* Rost., Mon., p. 196 (in part); Cooke, Myx. Brit., p. 46 (in part); Mass., Mon., p. 85 (in part); Macbride, in Bull. Nat. Hist. Iowa, ii., p. 142. *S. microspora* List., Morgan, in Cinc. Soc. Nat. Hist., xiv., p. 54 (1894).

Plate XLIV., A.—*e*. sporangia of various sizes, × 2 (England); *f*. capillitium, × 180 (Central America); *g*. spore, × 600.

The type specimen from Nicaragua has smaller and more delicate sporangia than the usual form, which is found throughout the world. The longer stalks and minute spores characterise all gatherings, and distinguish this species from *S. ferruginea*. The twenty-six specimens in the Kew Herb. are marked *S. microspora* Lister, but the description of *S. Smithii* is the first published account of the species.

Hab. On dead wood.—Epping Forest, Essex (L:B.M.86); Dudley, Stafford (L:B.M.86); Luton, Beds (L:B.M.86); Berlin (B. M. 622); Freiburg, Germany (Strassb. Herb.); Bohemia (K. 729); Mauritius (K. 752); Ceylon (B. M. 646); New Zealand (K. 771); Australia (K. 758); Mass., U.S.A. (B. M. 641); Iowa (B. M. 819, 1005); S. Carolina (B. M. 644); Nicaragua (B. M. 1004); Darien (B. M. 643); Chili (Paris Herb.); Brazil (B. M. 1092).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS

6. **S. Tubulina** Alb. & Schw., Consp., p. 102. Æthalium at first white, soft, 1½ to 2 inches broad, 4 to 6 lines high, orbicular, rarely suboblong, basal membranes stout, silvery, pellucid, iridescent, easily removable from the substratum; surface smooth, shining, with hemispherical warts above, corresponding to the

apices of the component sporangia; columella brown, slender, capillary, aggregated, but for the most part individually free; capillitium loosely interwoven into a common mass; mass of spores brown.

Hab. On decorticated pines.—Germany.

This description applies to *S. splendens*, γ. *flaccida*; but without the character of the spore-markings, which could not be discerned by the older authors, no certain conclusion as to the species can be arrived at.

7. **S. fluminensis** Speg., in Ann. Soc. Cient. Argent, xii., p. 255 (1881). Hypothallus very thin, broadly effused, mucedinous, black, rather shining; stem erect, rather rigid, black, shining, 0·5 to 1 mm. long, 0·6 to 0·7 mm. thick; smooth when moist, rugulose when dry, subcontorted, extending into the sporangium as a columella, not reaching to the apex; sporangium cylindrical, rarely subclavate, rounded at both ends, 0·8 to 1·2 mm. long, 0·2 to 0·3 mm. thick, black, opaque, wall persistent for a long time; capillitium arising from the columella, forming a rather dense network, the superficial meshes equal to or twice the diameter of the spores, with uncinate incurved tips; spores 5 to 8 μ diam., smooth, smoke-brown.

Hab. On old bark and moss.—Brazil.

This description applies to a small form of *Comatricha typhoides*.

SPECIES EXCLUDED FROM THE GENUS.

S. æqualis Mass.	= *Comatricha obtusata* Preuss.
S. affinis Mass.	= *Comatricha typhoides* Rost.
S. atra Mass.	= *Comatricha typhoides* Rost.
S. Carlylei Mass.	= *Comatricha typhoides* Rost.
S. Friesiana de Bary	= *Comatricha obtusata* Preuss.
S. laxa Mass.	= *Comatricha laxa* Rost.
S. longa Mass.	= *Comatricha longa* Peck.
S. pulchella Bab.	= *Comatricha pulchella* Rost.
S. subcæspitosa Mass.	= *Comatricha obtusata* Preuss.
S. tenerrima Berk. & Curt.	= *Comatricha pulchella* Rost.
S. typhina Mass.	= *Comatricha typhoides* Rost.
S. Virginiensis Rex	= See note under *Comatricha typhoides* Rost.

Genus 16.—**COMATRICHA** Preuss, in Linnæa, xxiv., p. 140 (1851). Sporangia cylindrical, ovoid or globose, gregarious or scattered; sporangium-wall evanescent (subpersistent in *C. typhoides*), stipitate, the stalk extending within the sporangium as a columella for half its length or more, branching above, and continued into the crisped or flexuose capillitium, which consists of numerous threads rising from all parts of the columella, combined into a more or less uniform network, not forming a superficial net.

The genus *Comatricha* is a somewhat artificial one ; it includes species which agree with *Lamproderma* in all characters but the persistent sporangium-wall, and with *Stemonitis* in all but the presence of the superficial net of the capillitium ; in *C. typhoides* the surface net is often developed on the lower half of the sporangium ; at the same time it is a useful genus, typically marked by the uniform network of the capillitium and by the isolated, not fasciculate, growth of the sporangia.

KEY TO THE SPECIES OF *COMATRICHA*.

A. Spores dark, brownish-violet, or grey :—

a. Spores nearly smooth—

Capillitium dense, crisped, and flexuose throughout ; on wood. 1. *C. obtusata*

Capillitium large, primary branches stout and nearly straight ; on wood. 2. *C. laxa*

b. Spores spinulose—

Sporangia globose ; on leaves. 3. *C. lurida*

Sporangia much elongated, slender and cylindrical ; on wood. 4. *C. longa*

B. Spores pale, lilac, or reddish-lilac :—

a. Spores marked with a few widely scattered warts, the remaining surface nearly smooth or delicately reticulated, 4 to 6 μ diam. ; on wood. 5. *C. typhoides*

b. Spores spinulose, 6 to 10 μ diam.—

Sporangium-wall completely evanescent ; on leaves. 6. *C. Persoonii*

Sporangium-wall persistent at the base as a membranous cup ; on leaves. 7. *C. rubens*

1. **Comatricha obtusata** Preuss, *l.c.*, p. 141 (1851). Plasmodium watery-white, in rotten wood, maturing at the place of emergence. Total height 1 to 6 mm. Sporangia globose, ellipsoid or cylindrical, stipitate, scattered or gregarious, about 0·6 mm. diam., purplish-brown ; sporangium-wall evanescent. Stalk subulate, slender, black, shining ; in the globose form usually 2 to 6 times the length of the sporangium ; equalling the length of the sporangium, or shorter in the cylindrical form ; rising from a more or less distinct hypothallus. Columella reaching to half the height, or nearly to the apex of the sporangium, branching above and continued into the capillitium. Capillitium a more or less dense tangle of purplish-brown threads, springing from all parts of the columella, anastomosing and branching in semicircular curves ; of nearly equal thickness throughout, the ultimate branches looped, showing few free ends, but connected

with the evanescent sporangium-wall by short points. Spores brownish-violet, nearly smooth, or minutely and closely spinulose, 7 to 11 μ diam. *Stemonitis obtusata* Fr., Symb. Gast., p. 17 (1818). *Comatricha alta* Preuss, in Linnæa, xxiv., p. 141. *Stemonitis nigra* Pers., in Gmel., Syst. Nat., p. 1467 (1791). *Comatricha nigra* Schroet., Pilze Schles., i., p. 118 (1889); Blytt, Bidr. K. Norg., Sop. iii., p. 8. *Stemonitis Friesiana* de Bary, in Rabenh., Fungi Europ., No. 568 (1863); Mass., Mon., p. 82. *Comatricha Friesiana* Rost., Mon., p. 199 (1875); Cooke, Myx. Brit., p. 48. *C. subcæspitosa* Peck, in Rep. N. York Mus., xliii., p. 25. *Stemonitis subcæspitosa* Mass., Mon., p. 80. *Comatricha æqualis* Peck, in Rep. N. York Mus., xxxi., p. 42. *Stemonitis æqualis* Mass., Mon., p. 80. *Comatricha Suksdorfii* Ellis & Everh.; N. Am. Fungi Exs. *Stemonitis Suksdorfii* Mass., Mon., p. 76.

Plate XLIV., B.—*a*. sporangia of various forms, × 3½; *b*. sporangia with spores dispersed, showing capillitium, × 20; *c*. capillitium with flexuose threads, forming a loose tangled network, × 180; *d*. capillitium with much branching flexuose threads forming a close network, × 180; *e*. capillitium with threads uniting to form a superficial net more or less parallel with the surface, × 180; *f*. spore, × 600 (England).

A very abundant species in Europe, and subject to much variation in the shape and size of the sporangium. *C. æqualis* Peck has cylindrical sporangia about 3 mm. long, and stalks of the same length; the capillitium and spores, 7 μ diam., agree with those of *C. obtusata*, from elongated forms of which *C. æqualis* cannot be distinguished. *C. subcæspitosa* Peck is a small delicate form, 2 mm. in height, with sporangia ellipsoid, and capillitium a network of slender flexuose violet-brown threads, forming a more or less distinct superficial net in the lower part; the spores are almost smooth, and measure 10 to 11 μ; although an unusually short-stalked delicate form, it presents no characters by which it can be separated from *C. obtusata*. *C. Suksdorfii* Ellis & Everh. is about the same height as *C. æqualis*; the capillitium is very dense, but not more so than is frequently seen in globose sporangia of *C. obtusata*; the spores are unusually dark and large, 10 to 11 μ; the tone of colour and the distribution of the minute warts are, however, the same as in the last-named species, from which it is not otherwise to be distinguished; a similar form has been found in England, with spores 8 to 10 μ diam. *C. æqualis* Peck, *C. subcæspitosa* Peck, and *C. Suksdorfii* are represented in the British Museum by glycerine jelly mountings from type specimens furnished by Dr. Rex.

Hab. On dead wood.—Batheaston, Somerset (B. M. 220); Lyme Regis, Dorset (L.B.M.87); Boynton, Yorkshire (B. M. 1095); France (Paris Herb.); Germany (B. M. 605); Finland (B. M. 612); Poland (Strassb. Herb.); Philadelphia (L.B.M.87).

2. **C. laxa** Rost., Mon., p. 201 (1875). Plasmodium watery-white, in rotten wood. Total height, 1·5 to 3·5 mm. Sporangia subglobose or shortly cylindrical, obtuse, scattered or gregarious. Stalk black, shining, often stout, 0·3 to 0·6 mm. long. Columella reaching nearly to the apex of the sporangium, narrowed upwards. Capillitium lax, the primary threads springing somewhat distantly from all parts of the columella, at first straight or

slightly curved, branching towards the surface to form a loose network of slender threads, either looped or with numerous straight free ends. Spores as in *C. obtusata*. *Stemonitis laxa* Mass., Mon., p. 79. *Badhamia penetralis* Cooke & Ellis, in Grev., v., p. 49. *Comatricha Ellisiana* Ellis & Everhart, N. Am. Fung., 2nd series, 2696. *Comatricha Sommerfeltii* Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 8.

Plate XLIV., B.—*g*. sporangia of various forms on wood and bramble, × 3½ ; *h*. sporangia with spores dispersed, showing capillitium. × 20 ; *i*. apex of columella, and capillitium threads, × 180 ; *k*. spore, × 600 (England).

Intermediate forms connect this species with *C. obtusata*, of which it is hardly more than a marked variety. The type in the Strassburg collection is well rendered by the photographic figure in Rostafinski's Monograph ; it is a globose form with coarse and lax capillitium. A similar form is found at Lyme Regis, together with growths having more elongated sporangia ; among these there occur forms which are identical with *C. Ellisiana* Ellis & Everh. (K. 1590), and with specimens furnished by Dr. Rex under the same name (L:B.M.88). *C. Sommerfeltii* Blytt has the lax capillitium of Rostafinski's type of *C. laxa*, with larger spores, 11 to 14 μ diam. ; the size of the spores, which in other respects are those of *C. laxa*, can scarcely support a separate specific rank being given to this gathering. I am indebted to Prof. Blytt for kindly submitting the type of *C. Sommerfeltii* for examination.

Hab. On dead wood, twigs, etc.—Leytonstone, Essex (L:M.B.88) ; Lyme Regis, Dorset (L:B.M.88) ; Germany (Strassb. Herb.) ; Norway (L:B.M.88) ; Philadelphia (L:B.M.88) ; S. Carolina (B. M. 922).

3. **C. lurida** Lister, sp. nov. Plasmodium ? Total height 1·25 mm. Sporangia globose or subovoid, erect, 0·5 mm. diam., stipitate, scattered, purplish-brown ; sporangium-wall evanescent. Stalk setaceous, black, shining, 0·75 mm. long, rising from a circular brown hypothallus. Columella cylindrical, reaching to half the height of the sporangium, dividing into stout branches at the apex, and continued into the capillitium. Capillitium dark purplish-brown throughout, spreading from the upper part of the columella in flexuose anastomosing threads, with slender, brown, free ends. Spores spherical or subovoid, purplish-grey, coarsely warted, 8 to 10 μ diam.

Plate XLV., B.—*a*. sporangia, × 3½ ; *b*. columella and capillitium, with a fragment of sporangium-wall, to which spores adhere, × 180 ; *c*. spore, × 600 (England).

This species has occurred at Lyme Regis during several years, with constant characters ; it has the habit of *Lamproderma irideum*, from which it is distinguished by the more branching columella, the uniform colour of the flexuose capillitium, and also in the larger and more strongly warted spores. It resembles some forms of *C. obtusata*, differing essentially in the spores and habitat.

Hab. On dead leaves.—Lyme Regis, Dorset (L:B.M.89).

4. **C. longa** Peck, in Rep. N. York Mus., xliii., p. 24 (1890). Plasmodium ? Total height 4 mm. to 4 cm. Sporangium

cylindrical, elongated and slender, flexuose or drooping, stipitate, at first fasciculate, greyish-black; sporangium-wall evanescent. Stalk very slender, 1 to 3 mm. long, black, rising from a well-developed, membranous hypothallus. Columella continued to near the apex of the sporangium, very slender, and wavy with angular flexures in the upper part, tapering in breadth from 20 μ at the base to 2 μ near the summit. Capillitium a lax network of dark brown threads, the terminal branches rigid, free, forking at an acute angle. Spores dark grey, spinulose, the spines usually connected by faint lines forming a reticulation, 8 to 9 μ diam.—Macbride, in Bull. Nat. Hist. Iowa, ii., p. 140; Morgan, Cinc. Soc. Nat. Hist., xvi., p. 50. *Stemonitis longa* Mass., Mon., p. 83.

α. **genuina**: capillitium rigid; spores spinulose, reticulated.

β. **irregularis**: capillitium with flaccid terminal branchlets; spores spinulose.—*Comatricha irregularis* Rex, in Proc. Acad. N. Sc. Phil. (1891), p. 393. *Comatricha crypta* Macbride, in Bull. Nat. Hist. Iowa, ii., p. 139.

Plate XLV., A.—*a.*, *b.* sporangia, *a. genuina*, × 3½; *c.* capillitium from upper part of sporangium, with slender flexuose columella, × 180; *d.* capillitium from lower part of another sporangium, × 180; *e.* spores of same, showing varying amount of reticulation, × 600; *f.* sporangia of *β. irregularis*, × 3½; *g.* capillitium, × 180; *h.* spore of same, × 600; *i.* spore of *C. crypta* Macbride, showing faint indication of reticulation, × 600 (U.S.A.).

From the absence of any superficial net in the capillitium this species is placed in *Comatricha*, though in its fasciculate habit it resembles a *Stemonitis*. In *a*, the capillitium varies in different gatherings; in some the threads are comparatively short, rigid throughout, and anastomosing but little; in others they form a profuse network with many membranous expansions, and very slender free ends, but the character of the dark spinulose spores remains constant in all forms. *β* is described by Dr. Rex (*l.c.*, p. 393) under the name of *Comatricha irregularis*; the terminal branches of the capillitium are produced into a network of pale flaccid threads with many free ends; Dr. Rex (in litt.) states that this form is constant in the character of the capillitium, and that it has been obtained from five states in North America; the total length of the sporangia varies from about 4 to 7 mm., but the close resemblance in the capillitium and spores to forms of *C. longa* leads to the conclusion that it is a varietal development of that species. It is the form described under the name of *C. crypta* Macbride, *l.c.* (teste Rex). The type specimen of *Stemonitis crypta* Schwein. is, Dr. Rex states, utterly lost, and the description is too vague to be of value.

Hab. On the bark of fallen trees (teste Macbride).—*a.* and *β.* Ohio (L:B.M.90); *a.* Philadelphia (B. M. 900); *β.* Philadelphia (L:B.M.90); *β.* Iowa (B. M. 1006); *a.* S. Carolina (B. M. 915); *a.* Cuba (K. 1603); *a.* Nicaragua (K. 718).

5. **C. typhoides** Rost., Versuch, p. 7 (1873). Plasmodium watery-white, in rotten wood. Total height 2 to 3 mm. Sporangia cylindrical, obtuse, at first silvery-grey from the presence of the soon evanescent wall, then brown; stipitate, aggregated, 1·5 to

2·3 mm. long, 0·5 mm. broad. Stalk black, often clothed with the grey membranous continuation of the sporangium-wall; 0·5 to 1·3 mm. long, 0·06 mm. thick, rising from a well-developed hypothallus. Columella reaching nearly to the summit of the sporangium, branching at the apex. Capillitium a close network of flexuose, pale-brown threads, springing from all parts of the columella, the ultimate branches more slender, free, or continuous and looped in the lower half, resembling the superficial net of *Stemonitis*. Spores pale lilac-brown, marked with 3 to 5 dark, flattened warts on the hemisphere; otherwise almost smooth, minutely warted or faintly reticulated, 3·5 to 7 μ diam.—*Trichia typhoides* Bull., Champ., p. 119 (1891). *Stemonitis typhoides* DC., Fl. Franc., ii., p. 257. *Stemonitis typhina* Wiggers, Prim. Fl. Hols., p. 110 (1780); Pers., Obs., i., 57; Mass., Mon., p. 74. *Comatricha typhina* Rost., Mon., p. 197 (1875); Cooke, Myx. Brit., p. 47. *C. affinis* Rost., Mon., p. 202. *Stemonitis affinis* Mass., Mon., p. 76. *S. atra* Mass., Mon., p. 78. *S. Carlylei* Mass., Mon., p. 84.

α. **genuina**: sporangium-wall subpersistent; spores 6 to 7 μ diam., surface almost smooth, or minutely warted between the larger warts.

β. **heterospora** Rex, in Proc. Acad. Nat. Sc. Phil., 1893, p. 367: sporangium-wall evanescent; spores 5 to 6 μ diam.; surface marked with faint, broken reticulation between the warts.

γ. **microspora**: sporangium-wall evanescent; spores 3·5 to 4·5 μ diam., sculpture of spores as in *β*.

Plate XLVI., A.—*a*. sporangia, *α. genuina*, × 3½; *b*, *c*. dense and lax forms of capillitium, × 180; *d*, *e*. spores of the same, showing widely scattered warts, × 600 (England); *f*. sporangia, *β. heterospora*, × 3½; *g*. spore, faintly reticulated between the warts, × 600 (U.S.A.); *h*. sporangia, *γ. microspora*, × 3½; *i*. capillitium, × 180; *j*. spore, × 600 (England); *k*. spore of *Stemonitis Virginiensis* Rex, × 600 (U.S.A.).

Plate XLVI., B.—*a*. sporangia intermediate between *α* and *β*, × 3½; *b*. capillitium, × 180; *c*. spore, minutely warted between the large scattered warts, × 600 (Iowa).

The capillitium varies in the closeness of the network; forms occur in which the threads are less flexuose, and bear nearly the same relation to the type as *C. laxa* to *C. obtusata*. The scattered warts on the spores, the existence of which was first pointed out by Dr. Rex, is a character which, although requiring a high magnifying power to identify, is present in all the varieties given above, and is additional evidence that they all belong to a single species. *γ. microspora* is represented by a gathering in perfect development from Lyme Regis; in form and colour it resembles *β*, but the spores are uniformly minute. A specimen received from Mr. Morgan, Ohio, is almost identical, with spores of the same size. Specimens of *C. typhoides, α.*, have been received from Prof. Macbride, Iowa, under the name of *C. pulchella* (B. M. 1007); the sporangia are cylindrical, and the spores, which measure 6 to 7 μ, are marked with minute warts, and a few inconspicuous larger warts. This form is connected with the more usual type by other specimens from Iowa with minutely warted spores in which the few larger warts are well developed (L:B.M.91; Plate XLVI., B., *a.* to *c.*). The type of *C. affinis* Rost.,

from Freiburg, in the Strassburg collection, is not well developed, as shown by the abundance of immature spores; but the capillitium is that of *C. typhoides*, and the spores have the characteristic scattered warts. *Stemonitis atra* Mass., from New Zealand (K. 727), has spores 6 to 8 μ diam., and appears to be the usual form of *C. typhoides*. *S. Carlylei* Mass. (Herb. Massee) is also *C. typhoides*, *a. genuina*, with almost colourless spores 6 to 7 μ diam., marked with the scattered warts. *Stemonitis Virginiensis* Rex, Proc. Acad. Nat. Sc. Phil. (1891), p. 391 (L:B.M.91) is represented by a single extensive gathering in the Alleghany Mountains, Virginia. The minute sporangia, 3·5 mm. in total height, are clustered but not fasciculated; the capillitium is an intricate network of delicate threads with an indefinite superficial net and numerous free ends; the spores measure about 6 μ diam., and show a distinct reticulation when magnified 1,200 diam. The more clearly reticulated spores appear to afford the only distinctive character separating it from *C. typhoides* var. *heterospora*; a high magnifying power shows the dark scattered warts before referred to.

Hab. On dead wood. Common.—*a.* Leytonstone, Essex (L:B.M.91); γ. Lyme Regis, Dorset (L:B.M.91); France (Paris Herb.); *a.* Germany (Strassb. Herb., B. M. 629); *a.* Poland (Strassb. Herb.); *a.* Italy (B. M. 628); *a.* India (K. 1580); *a.* New Zealand (K. 727); *a.* and β. Philadelphia (L:B.M.91); Iowa (L:B.M.91); *a.* S. Carolina (B. M. 633).

6. **C. Persoonii** Rost., Mon., p. 201 (1875). Plasmodium watery-white, among dead leaves. Total height 0·7 to 2 mm. Sporangia ovoid or cylindrical, stipitate, scattered, lilac- or rufous-brown; sporangium-wall evanescent. Stalk black, 0·2 mm. high or more, rising from a circular, membranous hypothallus. Columella reaching nearly to the apex of the sporangium. Capillitium a network of flexuose, anastomosing, brown threads springing from all parts of the columella, looped at the surface, with few free ends. Spores pale lilac-brown or flesh-coloured, minutely warted, 6 to 8 μ diam.—*Stemonitis pulchella* Church. Bab., in Proc. Linn. Soc., 1839, p. 32; Berk. in Ann. Mag. Nat. Hist., Ser. 1, vi., p. 431, Pl. 12, f. 11; Mass., Mon., p. 86. *Comatricha pulchella* Rost., Mon., App., p. 27; Cooke, Myx. Brit., p. 49; Macbride in Bull. Nat. Hist. Iowa, ii., p. 139. *Stemonitis tenerrima* Curt. in Sill. Journ., vi., p. 352; Berk. & Curt., in Grev., ii., p. 69.

a. **genuina**: sporangia shortly cylindrical, 0·7 to 1 mm. high, on short stalks; spores pale brown with a lilac tinge.

β. **tenerrima**: sporangia narrowly ovoid, 0·4 to 0·7 mm. high, on stalks of the same length, capillitium threads very delicate; spores flesh-coloured. *Stemonitis tenerrima* Curtis *l.c.*

Plate XLVI., B.—*d.* sporangia, *a. genuina*, × 3½; *e.* capillitium, × 180; *f.* spore, × 600; *g.* sporangia, β. *tenerrima*, × 3½; *h.* capillitium, × 180; *i.* spore, × 600 (England).

The description of *S. tenerrima* Mass., Mon., p. 81, with spores black in mass, 13 to 14 μ diam., can only be accounted for by some confusion of specimens, as it agrees neither with Berkeley's type (K. 1588), nor with his description in Grevillea.

a. genuina is the type most abundant in Europe.

β. tenerrima is the type of *Stemonitis tenerrima* Berk. & Curt., from S. Carolina; it occurs in Ravenel's Coll. (B. M. 902) under the name of *Comatricha pulchella*: it has also been found at Lyme Regis. *Comatricha gracilis* Wing. (No. 2094, Ellis & Everhart, 2nd Series, K. 1589) is similar to specimens furnished by Dr. Rex as a small form of *C. Persoonii* (L:B.M.92); it differs from the usual type in the very faintly and closely warted spores.

Hab. On dead leaves, etc.—*a.* and *γ.* Lyme Regis, Dorset (L:B.M.92); *a.* Leytonstone, Essex (L:B.M.92); *a.* Luton, Beds. (L:B.M.92); *β.* Philadelphia (L:B.M.92); *a.* S. Carolina (B. M. 904*b*); *γ.* S. Carolina (B. M. 902).

7. **C. rubens** Lister, sp. nov. Plasmodium watery-white. Total height 1 to 2 mm. Sporangia obovoid, ellipsoid, or subglobose, stipitate, erect or inclined, scattered, 0·5 to 0·8 mm. long, 0·3 to 0·5 broad, pinkish-brown, shining below; sporangium-wall evanescent above, membranous and persistent in the lower quarter, pinkish-brown. Stalk setaceous, black, shining, 0·6 to 1·3 mm. long, rising from a circular brown hypothallus. Columella reaching to about two-thirds the height of the sporangium, branching at the apex. Capillitium of brownish-violet threads, springing from all parts of the columella, broad at the base, more or less flexuose, anastomosing and branching at wide angles, often with flat expansions, gradually narrowing to the delicate straight free ends; the persistent base of the sporangium-wall is connected with the lower part of the columella by capillitium threads with broad attachments. Spores pale lilac-brown, minutely spinulose, 7 to 8 μ diam.

Plate XLV., B.—*d.* sporangia, × 3½; *e.* columella and capillitium, with the basal part of sporangium-wall persistent, × 180; *f.* spore, × 600 (England).

This species has occurred at Lyme Regis two years in succession, and has also been obtained in Yorkshire and Bedfordshire. Specimens from America supplied by Dr. Rex are of precisely the same form as the English gatherings. The spores are similar to those of *C. Persoonii*, to which species it appears to be allied. The persistent wall at the base of the sporangium is a constant character, showing an approach to the genus *Lamproderma*.

Hab. On dead leaves.—Lyme Regis, Dorset (L:B.M.93); Philadelphia (L:B.M.93).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

8. **C. macrosperma** Racib., in Rozpr. Mat. Przyr. Akad. Krak., xii., p. 76 (1884). Sporangia obovate, or oblong, naked, stipitate; columella tapering upwards, ceasing below the apex; capillitium arising from the columella, its branches combined into a not dense net, becoming gradually more slender towards the circumference, where, especially in the lower part of the sporangium, their curved extremities unite to form a superficial net. Spores pale violet, verruculose, 9·9 to 12 μ diam. Var. *obovata*, sporangia 0·5 to

0·75 mm. broad. Var. *oblonga*, sporangia 0·75 to 1 mm. long, 0·3 to 0·5 mm. broad.

Hab. Near Cracow.

This description applies to a form of *C. obtusata* with spores rather more distinctly warted than usual.

Genus 17.—**ENERTHENEMA** Bowman, in Trans. Linn. Soc., xvi., p. 152 (1830). Sporangia stipitate; columella reaching to the apex of the sporangium; capillitium springing from beneath the superficially extended end of the columella.

1. **E. elegans** Bowm., *l.c.*, p. 152, tab. 16 (1830). Plasmodium watery-white. Total height 1 to 1·5 mm. Sporangia globose, stipitate, erect, gregarious, 0·5 to 0·75 mm. diam., dull black, crowned with the small iridescent salver-shaped apex of the columella; sporangium-wall evanescent. Stalk conical, black. Columella slender, cylindrical from a conical base, traversing the sporangium and expanding on the surface into a membranous umbilicate disc 0·1 to 0·2 mm. broad. Capillitium threads spreading from the expanded apex of the columella, long, slender, black, sparingly branched, straight or flexuose. Spores greyish-brown, spinulose, 8 to 10 μ diam.—Mass., Mon., p. 105. *Stemonitis papillata* Pers., in Römer, N. Mag. Bot., p. 90; Berk. in Eng. Fl., vol. v., ii., p. 317. *Enerthenema papillata* Rost., Mon., App., p. 28; Cooke, Myx. Brit., p. 51. *E. elegans* Berk. & Br. in Ann. Mag. Nat. Hist., Ser. 2, vol. v., p. 366. *E. Berkleyana* Rost., Mon., App., p. 29; Mass., Mon., p. 106. *Ancyrophorus crassipes* Raunkiær, in Bot. Tidssk., xvii., p. 93, t. v., figs. 8, 9; Mass., Mon., p. 107.

Plate XLVII., A.—*a.* sporangia, × 20; *b.* sporangia with spores dispersed, showing capillitium arising from under the apical disc of the columella, × 35; *c.* sporangia with capillitium arising from the whole length of the columella, and anastomosing to form more or less of a network; found in company with sporangia with normal capillitium, × 35; *d.* spore, × 600 (England).

Occasionally the capillitium threads are much branched and spring from all parts of the columella, which may then terminate below the apex of the sporangium; but all conditions between this and the normal form occur in the same group of sporangia. The account with the figure of *Ancyrophorus crassipes* Raunkiær, *l.c.*, well describes this variety. In what remains of the type of *E. Berkeleyanum* Rost., from S. Carolina (K. 1643), no spores of an *Enerthenema* can be detected; the specimen is beset with clusters of brown spores or dividing cells of a parasitic fungus. Berkeley and Broome describe this specimen as having the "spores produced in little heads surrounded by a common vesicle at the free apices of the flocci," and of this being "almost the only case in which the spores of a Myxogaster have been observed *in situ*; Ptychogaster is the single exception." The sporangia are of the typical form of *E. elegans*, and it appears possible that the mould was mistaken by Berkeley and Broome for the true spores.

Hab. On dead wood.—Wanstead, Essex (L:B.M.94); Lyme Regis, Dorset (L:B.M.94); Portbury, Somerset (B. M. 236); Batheaston, Somerset (B. M. 238); Edinburgh (K. 1642); Germany (Strassb. Herb.); S. Carolina (K. 1643).

SPECIES EXCLUDED FROM THE GENUS.

E. muscorum Lév. = *Lamproderma irideum* Mass.

Genus 18.—**LAMPRODERMA** Rostafinski, Versuch, p. 7 (1873). Sporangia stalked, globose or ellipsoid; sporangium-wall membranous, somewhat persistent, shining with iridescent colours; stalk black; columella cylindrical or clavate, reaching to half or more than half the height of the sporangium; capillitium consisting of branched anastomosing threads, radiating from the upper part of the columella.

KEY TO THE SPECIES OF *LAMPRODERMA*.

A. Total height 2 to 3 mm.

Capillitium purplish throughout, spores spinulose, 10 to 13 μ.
1. *L. physaroides*

Capillitium black or grey, spores echinulate, 15 to 20 μ.
2. *L. echinulatum*

B. Total height 1 to 1·5 mm.

a. Columella branching at the apex. 3. *L. arcyrionema*

b. Columella obtuse or truncate.

Threads of capillitium dark, pale at the base.
4. *L. irideum*

Threads of capillitium dark or pale, not paler at the base.
5. *L. violaceum*

1. **L. physaroides** Rost., Mon., p. 202 (1875), and App., p. 25. Plasmodium? Total height 2 to 3 mm. Sporangia globose or ellipsoid, stipitate, erect, rarely sessile, gregarious, 0·5 to 0·8 mm. diam., purplish-black with broken iridescent reflections, or shining like burnished brass; sporangium-wall membranous, persistent, purplish in the lower part, usually mottled with darker shades. Stalk cylindrical, usually 1·5 mm. high, 0·15 mm. thick, purplish-black, shining, longitudinally striate or rugose, rising from a dark purplish hypothallus. Columella cylindrical with a conical apex, or clavate, reaching to more than half the height of the sporangium. Capillitium of purple-brown threads, rarely pale, radiating chiefly from the upper part of the columella, sparingly forked and anastomosing; towards the surface branching and forming a delicate, nearly colourless network. Spores purple-grey, closely spinulose, 11 to 14 μ diam.—Cooke, Myx. Brit., p. 49; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 7; Mass., Mon., p. 103. *Stemonitis physaroides* Alb. & Schw., Consp. Fung., p. 103 (1805). *Physarum columbinum* Pers., Obs. Myc., i., p. 5. *Lamproderma columbinum* Rost., Versuch, p. 7; in Fuckel, Symb., Nachtr, p. 69; Mon., p. 203; Mass., Mon., p. 100. *Physarum iridescens* Berk., in Hook. Journ. (1851), p. 20. *Lamproderma iridescens* Rost., Mon., App., p. 25.

a. **genuinum** : sporangia stalked.

β. **sessile** : sporangia sessile.

Plate XLVII., B.—*a.* sporangia, × 3½ ; *b.* sporangia, *a. genuinum*, × 20 ; *c.* columella and capillitium, × 80 ; *d.* columellæ of various shapes, from one group of sporangia, × 20 ; *e.* sporangia, *β. sessile*, × 20 ; *f.* capillitium of same, × 80 ; *g.* spore, × 600 (England).

The form *sessile* is represented by five separate gatherings. One from the Pyrenees, on *Hepaticæ*, is the type of *Stemonitis iridescens* Berk. (K. 1318) ; the sporangia, now broken, were globose, and either sessile or on short stalks ; the capillitium is described by Rostafinski as colourless, but in the sporangium examined, the few threads that remain are dark-brown ; the columella is absent, but the base of the sporangium is thickened by a tissue of interwoven bands ; the spores are purple-grey as in the type of *L. physaroides*. The second gathering is from Christiania, named *L. columbinum*, kindly furnished by Professor Blytt (L:B.M.95); it is on moss in company with the long stalked form of *L. physaroides* ; the globose sporangia are each seated on a horny base of dried plasmodium ; there is no stalk or columella ; the capillitium rises from the broad base of the sporangium and resembles that of the stalked form ; the spores measure 16 to 19 μ ; in the accompanying stipitate sporangia they measure 12 to 13 μ. Two other gatherings are from near Leighton Buzzard, one on fir bark, the other on dead leaves ; the sporangia are entirely without stalk or columella ; the capillitium rises from the broad membranous base of the colourless sporangium-wall, the threads are much branched and colourless at the base, dark purple-brown, forked and anastomosing above ; the spores are as in the type, 10 μ diam. The fifth is a gathering on fir bark by Mr. Saunders, at Flitwick, Beds : the sporangia are dull-brown ; the sporangium-wall pale amber, subcartilaginous, thickened at the base by interwoven folds as in the specimen from the Pyrenees; the capillitium is abundant, of almost simple purple-brown threads, pale at the points of attachment to the sporangium-wall ; the spores are of the typical colour and roughness, 9 to 11 μ diam. The form *genuinum* of this species is very constant in its main characters, yet it is met with in the collections almost as frequently under the name of *L. columbinum* as of *L. physaroides*. It is probable that both names were originally given to the same species, and that Albertini and Schweinitz were not acquainted with Persoon's type of *Physarum columbinum* when they gave the name of *S. physaroides*. The Strassburg collection does not here assist us. There are three specimens in that collection marked as Rostafinski's types of *L. columbinum* ; one is *L. physaroides*, one is the pale form of *L. violaceum*, and the third is *L. irideum*. The type of *L. physaroides* at Strassburg is the species described above in the text, and the same as that supplied by de Bary to Professor Bayley Balfour under that name ; this nomenclature having become established, *L. columbinum* is here placed as a synonym for *L. physaroides*.

Hab. On fir-wood, moss, etc.—*a.* Hanham, Gloucester (B. M. 204,205) ; *a. β.* Leighton, Beds (L:B.M.95) ; *a.* Moffat, Scotland (L:B.M.95) ; *a.* France (K. 628) ; *a.* Germany (B M. 603, 604) ; *β.* Pyrenees (K. 1318) ; *a.* and *β.* Norway (L:B.M 95) ; *a.* Mass., U.S.A. (L:B.M.95).

2. **L. echinulatum** Rost., Mon., App., p. 25 (1876). Plasmodium ? Total height 2 to 2·5 mm. Sporangia globose, stipitate, erect, gregarious, 0·5 to 1 mm. diam., steel-blue, iridescent; sporangium-wall membranous, somewhat persistent, purplish or

fuliginous. Stalk subulate or cylindrical, 1 to 1·5 mm. long, black, rising from a well-developed hypothallus. Columella cylindrical, obtuse, about half the height of the sporangium. Capillitium black or cinereous, spreading chiefly from the upper part of the columella, threads stout, sparingly forked and anastomosing, colourless and slender at the tips. Spores dark grey, echinulate with black spines, 15 to 20 μ diam.—Lister, in Journ. Bot. (1891), p. 261; Mass., Mon., p. 97. *Stemonitis echinulata* Berk. in Hook. Fl. Tasm., p. 268 (1860). *Lamproderma Listeri* Mass., Mon., p. 97.

Plate XLVIII., A.—*a.* sporangia, × 3½ (New Zealand); *b.* columella of same, × 80; *c.* sporangia, × 3½ (Tasmania); *d.* columella and capillitium of same, × 80; *e.* sporangia, × 3½ (Moffat); *f.* columella and capillitium, × 80; *g.* spore, × 600.

In the type specimen from Tasmania many of the stalks are misshapen and tumid, and the primary branches of the capillitium are soon lost in a flaccid network of grey threads with broad expansions at the nodes; somewhat similar appearances are met with both in the stalks and capillitium of *L. violaceum* when matured under unfavourable conditions, and it appears probable that this specimen is not a perfect development; the primary threads in some parts are continuous and branched towards the surface in the manner usual in *Lamproderma*. The specimen from New Zealand is mouldy and difficult to examine, but the capillitium forms less of a network, and more nearly approaches the Moffat gathering, which is in perfect development, and is that described in the text and in the Journ. Bot., *l.c.* The remarkable spores are of the same character in all the specimens, and until further examples are obtained it would seem well to include them under one species.

Hab. On dead wood.—Moffat, Scotland (L:B.M.96); Tasmania (K. 1621); New Zealand (L:B.M.96).

3. **L. arcyrionema** Rost., Mon., p. 208, App. p. 26 (1875). Plasmodium watery-white, in rotten wood. Total height 1 to 1·5 mm. Sporangia globose, stipitate, erect, aggregated, 0·5 mm. diam., steel-grey or bronze with iridescent reflections; sporangium-wall membranous, falling away in large fragments, often persistent as a collar round the base of the sporangium. Stalk subulate-setaceous, about 1 mm. high, black, shining. Columella slender, smooth, cylindrical, about 12 μ broad, reaching to one-third or one-half the height of the sporangium, suddenly dividing at the apex into the primary branches of the capillitium. Capillitium of dark purple-brown threads arising from the apex of the columella, branching repeatedly and anastomosing to form a close crisped network, with very short free ends. Spores lilac-grey, smooth or very faintly warted, 6 to 7 μ diam.—Mass., Mon., p. 96. *Stemonitis physaroides* var. *subaeneus* Berk., in Mass., Mon., p. 95. *Lamproderma subaeneum* Mass., *l.c.* *Comatricha Shimekiana* Macbride, in Bull. Nat. Hist. Iowa, ii., p. 380, Pl. x., fig. 3.

Plate XLVIII., B.—*a.* sporangia, × 3½ (United States); *b.* capillitium of same, × 180; *c.* sporangia, × 20 (England); *d.* columella and capillitium, × 80; *e.* spore, × 600.

This species is not unfrequent in the United States, where it is described by Dr. Rex as sometimes occurring in vast abundance, "covering one entire side of a fallen log about 3 feet in diameter for a length of about 10 feet with the steel-coloured sporangia." The specimens named by Berkeley *Stemonitis physaroides* var. *subaeneus*, from Ohio (K. 1560, 1562), correspond in every respect, in size, capillitium, and in the spores, which measure 6 to 7 μ, with Rostafinski's type of *Lamproderma arcyrionema* in Strassb. Herb. *Comatricha Shimekiana* Macbride, from Nicaragua (B. M. 1008), is a typical form of *L. arcyrionema*.

Hab. On dead wood.—Epping Forest, Essex (L:B.M.97); France (Paris Herb.); Poland (L:B.M.97); Borneo (L:B.M.97); Philadelphia (L:B.M.97); Ohio (L:B.M.97); Nicaragua (B. M. 1008).

4. **L. irideum** Mass., Mon., p. 95 (1892). Plasmodium watery-white, among dead leaves. Total height 1 to 1·5 mm. Sporangia globose, stipitate, erect, scattered or gregarious, 0·3 to 0·5 mm. diam., steel-blue or bronze, brilliantly iridescent; sporangium-wall delicately membranous, colourless, soon falling away in large fragments. Stalk setaceous, black, shining, rising from a purple-brown circular hypothallus. Columella cylindrical, truncate, scarcely reaching to half the height of the sporangium. Capillitium of rigid threads, radiating from the apex of the columella, dichotomously branching and anastomosing, black, purple-brown, rarely pale brown, pale at the base, rigid and coloured to the free extremities; the threads connecting the apex of the columella with the somewhat persistent base of the sporangium-wall usually delicate and colourless. Spores violet-grey, minutely warted, 6·5 to 8 μ diam.—*Stemonitis scintillans* Berk. & Br., in Journ. Linn. Soc., xv., p. 2 (1877). *Lamproderma arcyrioides* var. *iridea* Cooke, Myx. Brit., p. 50 (1877). *Enerthenema muscorum* Lév., in Ann. Sc. Nat., Ser. iv., xx., p. 289.

Plate L., A.—*a*. sporangia, × 3½; *b*. sporangia, × 20; *c*. columella and capillitium, × 80; *d*. branching thread of capillitium, showing the colourless base, × 180; *e*. spores, × 600 (England).

This species resembles some forms of *L. violaceum*, but is marked by the colourless base of the capillitium threads where they spring from the truncate apex of the columella; apart from the character of the capillitium, which is liable to some variation, it can always be distinguished by the spores, which instead of being minutely and closely spinulose, as in the pale-spored form of *L. violaceum*, are beset with scattered warts, which can easily be counted when magnified 1,500 diam., and number about thirty on the hemisphere. It is a most abundant species in England; in heaps of dead leaves it appears in countless numbers, and in a dark fir plantation near Lyme Regis the stones and herbage by the side of a rivulet appeared hoary over an area of many square yards with the young rising sporangia, and a little search showed the mature forms in equal abundance. The specimen in the Kew Collection from Ceylon (K. 1634) has the same character as the English gatherings, and is accurately described by Berkeley under the name of *Stemonitis scintillans* (l.c.). There are several specimens of this species in the Kew Collection, named *L. arcyrioides* var. *iridea* Cke. (K. 615—619); these are referred to in Mr. Massee's

Monograph, p. 95, and described as having smooth spores measuring 11 to 16 μ, which is misleading. Specimens received from the United States, representing several gatherings, agree in all respects with the type. The type of *Enerthenema muscorum* Lév. from New Granada (B. M. 1023) is a form of *L. irideum* with scattered sporangia on setaceous stalks, and dark capillitium ; the spores measure 8 to 9 μ, and are marked with 20 to 24 strong warts on the surface of the hemisphere, not including those seen on the margin. The warting is unusually pronounced, but in all other respects the specimen corresponds with frequent English gatherings.

Hab. On dead leaves. Common.—Lyme Regis, Dorset (L:B.M.91) ; Batheaston, Somerset (B. M. 194, 201) ; Highgate, London (B. M. 1111) ; France (B. M. 617) ; Poland (Strassb. Herb.) ; Ceylon (K. 1634) ; Philadelphia (L:B.M.98) ; Ohio (L:B.M.98) ; Iowa (B. M. 1000) ; S. Carolina (B. M. 846) ; New Granada (B. M. 1032).

5. **L. violaceum** Rost., Versuch, p. 7 (1873). Plasmodium watery-white. Total height 0·6 to 1·5 mm. Sporangia subglobose, more or less flattened and umbilicate beneath, or shortly ellipsoid, stipitate, erect, scattered or aggregated, 0·4 to 0·9 mm. diam., violet or bronze with iridescent reflections ; sporangium-wall membranous, somewhat persistent, pale violet-brown. Stalk varying from very short to one and a half times the height of the sporangium, black, rising from a red-brown membranous hypothallus. Columella one-third to two-thirds the height of the sporangium, cylindrical, obtuse, or sometimes narrowing to the apex. Capillitium of almost colourless, pale brown or dark violet-brown threads, springing from the upper part of the columella ; in the pale form branching and anastomosing in a flaccid network, becoming very slender towards the surface, varying in density in the same group of sporangia ; in the dark form the threads are either lax, or coarse and rigid, or flexuose and forming a close network. Spores purplish-grey or purple-brown, nearly smooth or minutely or strongly spinulose, 8 to 15 μ diam.—In Fuckel, Symb. Nachtr., p. 69 ; Mon., p. 204 ; Cooke, Myx, Brit., p. 50 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 8 ; Mass., Mon., p. 94. *Stemonitis violacea* Fr., Syst. Myc., iii., p. 162 (1829). *Stemonitis arcyrioides* Somm., in Mag. Nat., vii., p. 298 (1827). *Lamproderma arcyrioides* Rost., Mon., p. 206 ; Blytt, *l.c.*, p. 8 ; Cooke, Myx. Brit., p. 50; Mass., Mon., p. 102. *Stemonitis Carestiæ* Ces. & de Not., Erb. Crit. Ital., No. 888. *Lamproderma Sauteri* Rost., Mon., p. 205 ; Mass., Mon., p. 100. *Lamproderma robusta* Ellis & Everh., in Mass., Mon., p. 99. *Tilmadoche Berkeleyi* Mass., Mon., p. 332.

α. **genuinum** : sporangia globose, flattened beneath ; stalk slender ; capillitium nearly colourless, sometimes brown, flaccid ; spores 8 to 10 μ diam., minutely spinulose.

β. **Sauteri** : sporangia globose or subovoid ; thickened below ; capillitium brown ; spores 11 to 15 μ diam., nearly smooth or spinose.

γ. **Carestiæ**: sporangia subovoid; stalk short, stout; capillitium dense, dark violet-brown; spores 8 to 15 μ diam., nearly smooth or spinose.

Plate XLIX., A.—*a.* sporangia, *a. genuinum*, × 3½; *b.* sporangia, × 20; *c.* capillitium, × 80; *d.* spore, × 600 (England); *e.* small sporangia, × 3½ (United States); *f.* capillitium, β. *Sauteri*, × 80; *g.* spore of same, × 600 (Tyrol: Rostafinski's type of *L. Sauteri*); *h.* sporangia, γ. *Carestiæ*, × 3½; *i.* capillitium, × 80; *j.* spore of same, × 600 (Italy: type of *Stemonitis Carestiæ* Cesati); *k.* spore, × 600 (Jura Mts.: Fuckel, Fung. Rhen., 1447, one of Rostafinski's types of *L. arcyrioides*).

Plate XLIX., B.—*a.* sporangia, type of *Stemonitis arcyrioides* Somm., × 20; *b.* columella and capillitium, × 50; *c.* capillitium and spores, × 280; *d.* spore, × 600 (Norway).

The three varieties given above are well-marked centres, round which intermediate forms group themselves, and are essentially represented under their respective names by specimens in the Strassb. Herb.; but neither the size of the spores, the colour of the capillitium, nor the shape of the sporangia can be taken as giving constant specific characters. In some gatherings with dark and coarse capillitium the spores measure 9 μ diam., in others 11 to 14 μ diam.; they are either minutely or strongly spinulose. The original gathering on which Sommerfelt founded his *S. arcyrioides*, of which, through the courtesy of Prof. Blytt of Christiania, a mounting is in the Brit. Mus. Coll., has globose sporangia, with brown capillitium and nearly smooth spores 8 to 9 μ diam. The measurement "12·5 to 16·5 μ" given by Rostafinski, and repeated in other works, is erroneous, but is corrected by Prof. Blytt, *l.c.* It is a form of *a. genuinum* with dense capillitium. *L. Sauteri* Rost. has the same form of sporangium and brown capillitium as *S. arcyrioides* Somm., but has spinulose spores 11 to 14 μ diam.; it is the type of β. In Lyme Regis gatherings with pale, minutely spinulose spores, 8 to 10 μ diam., the capillitium is either almost colourless and flaccid, or brown and rigid, sometimes varying in sporangia on the same leaf. The characters on which specific differences can be based being so unstable, it appears reasonable to consider the three forms as varieties of one species. *Lamproderma robusta* Ellis & Everh., No. 39, N. Amer. Fun., as represented by the specimen received by Mr. Massee from Mr. Wingate, is β, with dark, strongly spinulose spores 11 to 13 μ diam.; it is almost identical with the type of *L. Sauteri* in the Strassb. Herb. The type of *Tilmadoche Berkeleyi* Mass., from the United States (K. 1563A), appears to be an immature specimen of *L. violaceum*.

Hab. On dead wood, leaves, etc.—*a.* Twycross, Leicester (B. M. 203B); Brockley, Somerset (B. M. 202); *a*, β. Lyme Regis, Dorset (L:B.M.99); *a.* France (Paris Herb.); *a*, β, γ. Germany (Strassb. Herb.); β, γ. Germany (B. M. 607); *a.* Norway (L:B.M.99); γ. Switzerland (B. M. 608); γ. Italy (B. M. 606); *a.* Mass., U.S.A (L:B.M.99); β. Philadelphia (L:B.M.99); γ. Iowa, Ohio (L:B.M.99).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

6. **L. Schimperi** Rost., Mon., p. 203. Sporangia globose, iridescent, greenish-black or reddish. Stalk black, shining, rigid, subulate, 3 to 4 mm. high, 0·6 mm. thick below, 0·15 mm. above. Columella obovate, hardly attaining half the height of the sporangium. Capillitium dusky, as in *L. physaroides*. Spores dull violet, delicately warted, 10 to 11 μ diam. Differing from

L. physaroides, which it very closely resembles, in the shape of the columella, and the smaller size and less strong warting of the spores.

Hab. Alsace (Schimper).

The characters above given are frequently met with in typical developments of *L. physaroides.*

7. **L. leucosporum** Rost., Mon., App., p. 26. Sporangia globose, 0·5 mm. diam., iridescent. Stalks black, shining, subulate, slender. Columella cylindrical, truncate. Capillitium dusky after the dispersal of the spores; composed of variously branching threads combined into a very dense network. Spores violet, smooth, 8 to 9 μ diam.—*L. nigrescens* Rost., Mon., p. 205.

Hab. Eberbach, Germany (Fuckel); Paris (Roze). The specimen from Roze has colourless capillitium.

This description applies to *L. violaceum.*

8. **L. Fuckelianum** Rost., in Fuckel, Symb., Nachtr., p. 69 (1873). Sporangia globose, almost sessile, 0·75 mm. diam., iridescent red, slightly umbilicate beneath. Stem short, inconspicuous, penetrating the sporangium as a short conical columella. Capillitium loosely branching, combined into a network by transverse branchlets. Spores pale violet, marked with minute ridges uniting to form a reticulation, 8 to 9 μ diam.—Mon., p. 207, tab. xiii., fig. 6.

Hab. On the twigs and leaves of oak.—Eberbach, Germany (Fuckel).

9. **L. minutum** Rost., Mon., App., p. 26. Sporangia globose, 0·6 mm. diam., somewhat iridescent. Stalks black, slender, cylindrical. Columella cylindrical, slender, truncate. Capillitium threads colourless, branching in a fasciculate manner; fascicles few. Spores violet, delicately verruculose, 6·6 μ diam.

Hab. Near Paris (Roze).

This description applies to a form of *L. irideum* with pale capillitium.

10. **L. nigrescens** Sacc., in Mich., ii., p. 262 (non Rost.) Sporangia gregarious, stipitate, globose, not umbilicate, smooth, erect, at first yellowish, then opaque black. Stalks filiform, 0·5 mm. high, 40 μ thick, black, with a small reddish hypothallus. Columella cylindrical, reaching half the height of the sporangium, giving rise at the obtuse apex to the radiating, dichotomously branching, filiform, dusky threads of the capillitium. Spores dull violet, very minutely echinulate, 9 to 10 μ diam.—*L. Saccardianum* Mass., Mon., p. 101.

Hab. On heaps of dead leaves and twigs.—N. Italy.

From the size of the spores it is probable that this is a minute form of *L. violaceum.*

11. **L. Ellisiana** Cooke, in Ann. Lyc. Nat. Hist. N. York, xi., p 397. Sporangia globose, stipitate, minutely rugulose, blackish-

purple, rather dull. Capillitium originating from the apex of the short columella, threads blackish-purple, very slender, equal throughout, repeatedly forking from the base, angles very acute. Stem coloured like the sporangium and twice as long, slender above, becoming very thick downwards, and expanding into a small circular hypothallus. Spores in clusters of five to seven, globose when free, pale lilac, minutely warted, 15 to 16 μ diam. About 1 mm. high.—Mass., Mon., p. 98. *Badhamia penetralis* Cooke & Ellis, Grev., v., p. 49.

Hab. On pine boards.—New Jersey.

Nothing now remains in the Kew Herb. (K. 614) of the specimens first issued by Ellis under the name of *B. penetralis* but a few subulate stalks. The specimens issued as *Comatricha Ellisiana* syn. *Lamproderma Ellisiana* Cke., *Badhamia penetralis* Cke. & Ellis, 2nd series, No. 2696 (K. 1590), are *Comatricha laxa*.

12. **L. Lycopodii** Raunk., in Bot. Tidssk., xvii., p. 109. Sporangia scattered, globose, sessile on a violet-brown hypothallus; wall, columella, capillitium, and spores violet-brown; the lower part of the wall remains with tattered margin. Columella cylindrical, reaching nearly half the height of the sporangium, giving rise in the upper part only to the capillitium, whose threads fork more and more towards the surface of the sporangium, where they are combined into a net by transverse branches, the extremities almost colourless. Spores furnished with a delicate network of fine thickenings, 12 to 18 μ diam.—*Stemonitis cribrarioides* Fr., Syst. Myc., iii., p. 163. *Cribraria Lycopodii* Fr. Nees, in Raunk. *l.c.*

Hab. On the leaves of *Lycopodium*.—Zealand.

SPECIES EXCLUDED FROM THE GENUS.

L. Hookeri Rost. = *Chondrioderma Hookeri* List.

Genus 19.—**CLASTODERMA** Blytt, in Bot. Zeit., xxxviii., p. 343 (1880); sporangia stalked, without lime; columella very short or hardly evident; capillitium arising from the apex of the columella in solid lilac or ochraceous threads, repeatedly forking, sparingly anastomosing; sporangium-wall dividing into subhyaline, membranous, rounded oblong or subpolygonal fragments, attached to one or from two to five of the ultimate branches of the capillitium; spores pale lilac.—*ORTHOTRICHIA* Wingate, in Journ. Myc., ii., p. 125 (1886).

1. **C. Debaryanum** Blytt, Bot. Zeit., xxxviii., p. 343 (1880). Plasmodium? Total height 1 to 1·25 mm. Sporangia globose, stipitate, gregarious, 0·15 to 0·2 mm. diam., brown; sporangium-wall membranous, persistent only in circular or polygonal plates attached to the ultimate branches of the capillitium. Stalks slender, rugose below, suddenly smooth and filiform in the upper fifth, brown. Columella short, dividing into the primary branches of the capillitium. Capillitium of pale brown threads, forking three or four times, sparingly anastomosing at the surface or free,

the ultimate branches attached singly or two or three together to the membranous plates of the sporangium-wall. Spores pale lilac, smooth, 7 to 10 μ diam.—Christ. Vidensk. Forh., No. 4 (1882); Bidr. K. Norg., Sop. iii. (1892), p. 7. *Orthotrichia microcephala* Wing., *l.c.*; Mass., Mon., p. 109.

Plate L., B.—*a.* sporangia, × 20; *b.* apex of stem, capillitium, and spores, × 280; *c.* part of capillitium from another sporangium, × 280 (United States); *d.* capillitium with expanded membranous plates, × 280 (Norway); *e.* spore, × 600; *f.* sporangium, × 20 (Norway).

This species was discovered by Prof. Blytt in 1879, near Christiania, growing on dead *Polyporus*. In the United States it has been repeatedly found, and described by Mr. Wingate as *Orthotrichia microcephala*. In these gatherings the threads anastomose more freely than in the Norwegian specimen, and the disc-shaped fragments of the sporangium-wall are usually less pronounced. In some sporangia, however, they agree essentially with the type kindly submitted for examination by Prof. Blytt, and it cannot be doubted that they are the same species.

Hab. On dead wood.—Norway (Christiania Herb.); Borneo (L:B.M.100); Philadelphia (B. M. 874); Ohio (L:B.M.100).

ALLIED GENERA NOT MET WITH IN THE QUOTED COLLECTIONS.

RACIBORSKIA Berl., in Sacc. Syll., vii., p. 400 (1888). Sporangia naked, globose, stipitate. Stem produced into a columella one-third or half the height of the sporangium, bearing at its apex short, slender, secondary columellæ, which branch again in a similar manner, the ultimate branches combining to form a network without free ends.—*Rostafinskia* Racib., in Rozpr. Mat. Przyr. Akad. Krak., xii., p. 77 (1884).

1. **R. elegans** Berl., *l.c.* Sporangia naked, globose, 0·5 mm. broad. Stalks erect, 1 to 2 mm. high, subulate, furrowed, black. Columella cylindrical, 8 to 10 μ wide. Capillitium blackish-violet, the branches becoming gradually more slender outwards, the ultimate branchlets furnished with scattered spines. Spores dull violet, 9 to 10 μ diam.—*Rostafinskia elegans* Racib., *l.c.*, p. 78.

Hab. Botanical Gardens, Cracow.

This description applies to *Comatricha obtusata*, in which the columella frequently branches in a dichotomous manner.

ECHINOSTELIUM de Bary, in Rost., Versuch, p. 7 (1873). Sporangia stalked, minute, naked, without columella. Capillitium arising from the apex of the stalk, its branches forming a network.

1. **E. minutum** de Bary, in Rost., Mon., p. 215, figs. 53, 54, 58, 68. Sporangia scattered, stipitate, globose, 37 to 57 μ diam., naked, whitish. Stalk 0·28 to 0·46 mm. high, brownish below, pale above. Capillitium of curved branching threads, with acute free branches. Spores entirely colourless, 6·7 to 8·3 μ diam.

Hab. Frankfort-on-Maine.

Order II.—AMAUROCHÆTACEÆ. Sporangia combined into an æthalium. Capillitium dark purple-brown, of irregular strands and threads, or of complex structure.

KEY TO THE GENERA OF *AMAUROCHÆTACEÆ*.

Capillitium of irregularly branching threads.

(20) AMAUROCHÆTE.

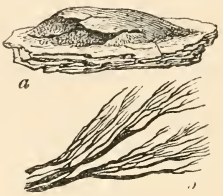

Fig. 28.—*Amaurochæte atra* Rost.
a. Æthalium. Half natural size.
b. Capillitium. Magnified 10 times.

Fig. 28.

Capillitium of horizontal threads, with many-chambered vesicles.

(21) BREFELDIA.

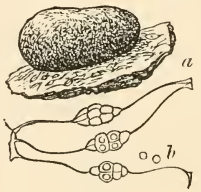

Fig. 29.—*Brefeldia maxima* Rost.
a. Æthalium. Natural size.
b. Capillitium and spores. Magnified 50 times.

Fig. 29.

Genus 20.—**AMAUROCHÆTE** Rostafinski, Versuch, p. 8 (1873). Æthalia pulvinate, composed of elongated closely compacted confluent sporangia; sporangium-walls not developed. Capillitium rising from the broad membranous base, consisting of dark purple-brown irregularly flattened ragged strands, dividing into many anastomosing branches, which vary much in length and thickness.

1. **A. atra** Rost., Versuch, p. 8 (1873). Plasmodium creamy-white, emerging from recently felled fir-wood. Æthalium pulvinate or variously shaped, 2 mm. to 4 cm. or more broad, black, covered with a silvery evanescent membrane; individual sporangium-walls undeveloped. Columella none. Capillitium as described in the genus, often very scanty. Spores dull purple, spinulose, 11 to 13 μ diam.—Mon., p. 211; Cooke, Myx. Brit., p. 52; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 9; Mass., Mon., p. 89. *Lycogala atrum* Alb. & Schw., Consp. Fung., p. 83 (1805). *Reticularia atra* Fr., Syst. Myc., iii., p. 86.

Plate LI., A.—*a*. capillitium, × 20; *b*. spore, × 600 (England).

Hab. On fir-wood.—Halse House, Somerset (B. M. 17); Scotland (Edin. Herb.); Lyme Regis, Dorset (L:B.M.101); Poland (Strassb. Herb.); Maine, U.S.A. (K. 800).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **A. minor** Sacc. & Ellis, in Michelia, ii., p. 566. Effused, varying, oblong, adnate-applanate, the margin almost naked, externally clay-colour, very minutely punctate, internally blackish. Capillitium threads filiform, sparingly branched and anastomosing, very pale brown. Spores blackish, minutely warted, then quite smooth, 15 μ diam.

Hab. On twigs.—Utah.

This description suggests an imperfect specimen of *Dictydiæthalium plumbeum*.

Genus 21.—**BREFELDIA** Rostafinski, Versuch, p. 8 (1873). Æthalia pulvinate, consisting of subcylindrical, somewhat branched and confluent sporangia, rising from a base of spongy barren tissue, which is continued, chiefly among the lower portions of the sporangia, in irregular folds, sometimes forming imperfect sporangium-walls and central columellæ. Capillitium of numerous horizontal threads, uniting at the surface of the sporangium to form many-chambered vesicles.

1. **B. maxima** Rost., Versuch, p. 8 (1873). Plasmodium white, in rotten stumps of fir, beech, etc. Æthalia 2 to 16 cm. broad, 5 to 10 mm. thick, purplish-brown, composed of elongated branching sporangia 0·3 to 0·5 mm. diam., extending upwards from the spongy basal tissue, which is continued among them as irregularly branching, purple-brown membranous folds, usually forming distinct rigid columellæ. Capillitium consisting of numerous threads radiating from near the central part of the sporangium; each thread expands at the boundary of the sporangium into a many-chambered vesicle, which is continued into a corresponding radial thread of the adjoining sporangium. The proximal ends of the threads are slightly attached in clusters of three or four by a fragile membrane. The vesicles are of firm structure, often containing a spore in several of the chambers, with no appearance of forming part of the sporangium-wall, except where they occasionally coalesce in fewer or greater numbers to form vertical scalariform strands. Spores purplish-brown, minutely spinulose, 9 to 12 μ diam.—Mon., p. 213; Cooke, Myx. Brit., p. 53; Mass., Mon., p. 91; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 389. *Reticularia maxima* Fr., Syst. Orb. Veg., i., p. 147 (1825). *Licea perreptans* Berk., in Gard. Chron. (1848), p. 451.

Plate LI., A.—*c*. subdiagrammatic view of portions of four columnar sporangia from an æthalium; each sporangium has a central columella, and is clothed on the surface with numerous vesicles, from which short capillitium threads pass into the adjacent sporangia; at *x* is seen a scalariform strand, formed by vertical union of a row of vesicles, × 50; *d*. capillitium threads and vesicles, × 180; *e*. spore, × 600 (England).

The complex structure of the capillitium is difficult to follow in the lower part of the æthalium; towards the surface the sporangia are often separated from each other by a narrow interval. The sides of the sporangia are then seen to glitter with the numberless vesicles of the capillitium. The threads penetrate the adjacent sporangia to the distance of 0·07 to 0·1 mm., or about half the radius. The entire length of the threads, including the central vesicle, is 0·15 to 0·23 mm. The spores in the central part of the sporangium do not seem to be traversed by any threads. In the lower strata the threads are sometimes attached at each extremity to folds of the membrane arising from the spongy base; but the rigid collumellæ, throughout the upper part at least, appear to be free from the capillitium.

Hab. On dead wood.—Lyme Regis, Dorset (L:B.M.102); Darenth, Kent (B. M. 1110); Wanstead, Essex (L:B.M.102); Luton, Beds (L:B.M.102); near Birmingham (L:B.M.102); Boynton, Yorkshire (B. M. 1159); France (Paris Herb.); Sweden (K. 781); Germany (Strassb. Herb.); Mass., U.S.A. (L:B.M.102); Iowa (B. M. 1020).

Rostafinskia australis Speg., in Ann. Soc. Cient. Argent., x., p. 151 (1880), is described as forming an æthalium and having the surface composed of softly velvety tomentum, breaking up into powdery filaments; the capillitium tubes of the lower stratum septate; the spores lilac, ovoid or irregular, 8 to 10 × 5 to 6 μ. It does not appear to be a Mycetozoon.

Cohort II.—*LAMPROSPORALES.* Spores variously coloured, never violet.

Subcohort I.—*ANEMINEÆ* Rost. (extended). Capillitium not forming a system of uniform threads; either wanting, or represented by modifications of the sporangium-wall, which may be perforated or laciniated in æthalioid sporangia, or produced into tubular extensions in exceptional forms in the order *Tubulinaceae.*

Order I.—HETERODERMACEÆ Rost. (extended). Sporangium-wall membranous, beset with microscopic round granules (plasmodic granules), and, except in *Lindbladia*, forming a net in the upper part; capillitium wanting; spores 4 to 7 μ diam.

KEY TO THE GENERA OF *HETERODERMACEÆ.*

Sporangia sessile, compacted or æthalioid, the wall not forming a net in the upper part. (22) LINDBLADIA

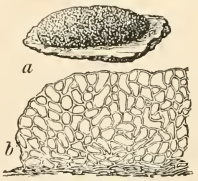

Fig. 30.

Fig. 30.—*Lindbladia Tubulina* Fries.
a. Æthalium. Natural size.
. Vertical section of æthalium. Magnified 6 times.

Sporangia stalked; sporangium-wall with thickenings in the form of a delicate persistent net expanded at the nodes.

(23) CRIBRARIA.

Fig. 31.

Fig. 31.—*Cribraria aurantiaca* Schrad.
a. Group of sporangia. Twice natural size.
b. Sporangium after dispersion of the spores. Magnified 20 times.

Sporangia stalked; sporangium-wall with thickenings in the form of nearly parallel ribs extending from the base to the apex, connected by delicate threads.

(24) DICTYDIUM.

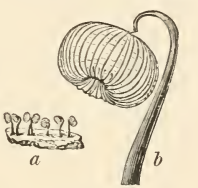

Fig. 32.

Fig. 32.—*Dictydium umbilicatum* Schrad.
a. Group of sporangia. Twice natural size.
b. Sporangium after the dispersion of spores. Magnified 20 times.

Genus 22.—**LINDBLADIA** Fries, Summa Veg. Scand., p. 449 (1849). Sporangia minute, either combined to form an æthalium, or closely compacted; rarely free, sessile, or stalked; sporangium-wall membranous, uniform, beset with microscopic, dark, plasmodic granules.

1. **L. Tubulina** Fries, *l.c.* (1849). Plasmodium? Sporangia minute, combined to form a more or less complex, effused or pulvinate æthalium, 1 to 10 mm. thick, black with a cortex of imperfectly developed spores, or umber-brown with the surface formed by the membranous walls of the convex summits of the component sporangia; hypothallus strongly developed, of membranous, more or less spongy tissue; sometimes the sporangia are shortly cylindrical and closely compacted, sessile, 0·3 to 0·5 mm. broad; in rare instances they are free and shortly stalked; sporangium-wall membranous, yellow-brown, uniform, beset with scattered clusters of dark, round, plasmodic granules, 1 μ diam. Stalk, when present, short, dark brown, rugose. Spores ochraceous-brown, faintly warted, 4 to 6 μ diam.—*Licea effusa* Ehr., Sylv. Myc. Berol., p. 26 (1818). *Lindbladia effusa* Rost., Mon., p. 223 (1875); Cooke, Myx. Brit., p. 55; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 115; Rex, in Bot. Gaz., xvii., p. 201. *Tubulina*

effusa Mass., Mon., p. 41. *Licea spermoides* Berk. & Curt., in Grev., ii., p. 68. *Tubulina spermoides* Mass., Mon., p. 37. *Physarum cæspitosum* Peck, in Rep. N. York Mus., xxvi., p. 75. *Perichæna cæspitosa* Peck, in Rep. N. York Mus., xxxi., p. 57. *Tubulina cæspitosa* Mass., Mon., p. 43.

α. **genuina**: sporangia combined into an æthalium.

β. **simplex** Rex: sporangia shortly cylindrical, closely compacted, sessile, rarely free and stalked.

Plate LI., B.—*a.* vertical section of part of a pulvinate æthalium, × 9; *b.* fragment of sporangium-wall and spores, × 280; *c.* closely compacted tubular sporangia, *β. simplex*, × 9; *d.* sessile and stalked sporangia, *β. simplex*, closely allied to *Cribraria argillacea*, × 9; *e.* fragment of sporangium-wall, and spores of same, × 280; *f.* spore, × 600 (United States).

The form *β. simplex* has hitherto been recorded only from the United States, and has been described by Dr. Rex (*l.c.*), where he gives a full account of the genus *Lindbladia* and of the relationship which exists between *L. effusa* and *Cribraria argillacea*. His gatherings show a complete series of intermediate forms between the two species. *Licea spermoides* Berk. & Curt. is var. *simplex* of Rex; it is represented by several specimens in the Kew Collection, including the type from Alabama referred to by Rostafinski in his App., p. 32, and given by him as a synonym for *Cribraria argillacea* (K. 1695); the sporangium-wall is bestrewn with dark plasmodic granules, but there is no indication of a net to warrant its being placed under *C. argillacea*.

Hab. On dead wood, etc.—*a.* Bulmer, Yorks (L:B.M.103); *a.* Aboyne, Scotland (B. M. 244); *a.* Sweden (K. 1658); *a.* and *β.* Philadelphia (L:B.M.103); *β.* Iowa (B. M. 822); *β.* S. Carolina (B. M. 948).

Genus 23.—**CRIBRARIA** Persoon, in Römer, Neues Mag. Bot., i., p. 91 (1794). Sporangia globose or subpyriform, stipitate; sporangium-wall persistent, and forming a cup in the lower half, or reduced to a basal disc, continued above in a net of slender threads more or less expanded and thickened at the nodes; the wall membranous and evanescent in the meshes of the net.

KEY TO THE SPECIES OF *CRIBRARIA*.

A. Nodes of the net not expanded:—

a. Sporangia clay-coloured, cup imperfectly defined, sporangium-wall subpersistent above. 1. *C. argillacea*

b. Sporangia crimson. 2. *C. rubiginosa*

c. Sporangia rufous or nut-brown, cup well-defined or obsolete—

Sporangia 0·6 mm. diam. 3. *C. rufescens*

Sporangia 0·1 to 0·2 mm. diam. 4. *C. minutissima*

B. Nodes of the net expanded :—

A. Sporangia nut-brown—

a. Cup perforated at the margin, merging into the branching nodes. 5. *C. macrocarpa*

b. Cup well-defined, nodes flattened, angular, branching, continued into the connecting threads. 6. *C. aurantiaca*

c. Cup replaced by strong ribs, nodes flattened. 7. *C. splendens*

d. Cup well-defined or absent, nodes thickened, prominent, numerous—

Nodes with many free rays, connected by more or less parallel delicate threads. 8. *C. intricata*

Nodes rounded in outline, with few or no free rays, connected by three to five delicate threads. 9. *C. tenella*

B. Sporangia purple- or red-brown—

a. Stalk two to three times the height of the sporangium, plasmodic granules 2 μ diam. 10. *C. pyriformis*

b. Stalk four to six times the height of the sporangium—

Cup one-third of the sporangium, nodes polygonal, plasmodic granules 0·5 to 1 μ diam. 11. *C. languescens*

Cup minute or absent, nodes rounded, prominent, plasmodic granules 1·5 to 2 μ diam. 12. *C. microcarpa*

C. Sporangia purple—

Cup one-third the sporangium, 0·7 mm. diam. 13. *C. purpurea*

Cup one-half the sporangium, 0·5 mm. diam. 14. *C. elegans*

D. Sporangia violet-blue, sporangium 0·25 mm. diam. 15. *C. violacea*

1. **C. argillacea** Pers., in Römer, N. Mag. Bot., i., p. 91 (1794). Plasmodium lead-coloured, in rotten wood. Total height 0·75 to 1·5 mm. Sporangia globose, crowded, stipitate, erect, or sessile, 0·5 to 0·8 mm. diam., clay-coloured; cup imperfectly defined; sporangium-wall subpersistent throughout, delicately membranous above, stouter towards the base, reticulated with strongly or faintly thickened bands, which are beset with dark plasmodic granules 1 μ diam., and form a net with hardly expanded nodes and subquadrangular meshes about 0·1 mm. wide. Stalk

cylindrical, 0·1 to 0·8 mm. high, furrowed, dark brown, arising from a well-developed hypothallus. Spores ochraceous, nearly smooth, 5 to 6 μ diam.—Rost., Mon., p. 238; Cooke, Myx. Brit., p. 59; Blytt, Bidr. K. Norg., Sop. iii., p. 10; Mass., Mon., p. 65. *Stemonitis argillacea* Pers., in Gmel., Syst. Nat., ii., p. 1469 (1791).

Plate LII., A.—*a*. sporangia, × 20; *b*. net of sporangium-wall and stalk, × 50; *c*. spores and plasmodic granules, × 600 (England).

This species varies much in the extent to which the net of the sporangium-wall is developed. In the usual form the bands are dark brown, well-defined, hardly expanded at the nodes, often stouter towards the base; but in some gatherings the thickenings are faint and broad, and the wall of the sporangium is nearly uniform in texture, in which case it closely resembles the form *β. simplex* of *Lindbladia Tubulina*.

Hab. On dead wood.—Richmond, Surrey (L:B.M.104); Birmingham (L:B.M.104); Leighton, Beds (L:B.M.104); Boynton, Yorkshire (B. M. 1044); Aboyne, Scotland (B. M. 243); Leicestershire (B. M. 244A); Germany (Strassb. Herb.); Norway (L:B.M.104); Philadelphia (L:B.M.104); Mass., U.S.A. (L:B.M.104).

2. **C. rubiginosa** Fries, Syst. Myc., iii., p. 172 (1829). Plasmodium? Total height 2 mm. Sporangia ellipsoid, shortly stalked, crowded, erect, 1·7 mm. high, 1 mm. broad, crimson; cup reaching to half the height of the sporangium, beset with minute dark plasmodic granules arranged in isolated clusters towards the base of the membranous wall, and in a reticulated pattern upwards, the lines becoming thickened and continued into the net at the somewhat perforated margin; net of delicate, dark brown, rigid threads with a mesh about 1 mm. diam., without conspicuous expansions at the nodes. Stalk rugged, dark brown, 0·3 to 0·5 mm. long, 0·2 mm. thick. Spores rufous, almost smooth, 5 to 6 μ diam.

Plate LII., B.—*a*. sporangia, natural size; *b*. sporangium after dispersion of spores, from a mounting in Canada balsam, × 20; *c*. net of sporangium-wall with margin of cup, × 180; *d*. spore, × 600 (Sweden).

This handsome species appears to be represented by the solitary Swedish gathering.

Hab. On fir needles.—Sweden (Edin. Herb.; L:B.M.105 *slide*).

3. **C. rufescens** Pers., in Römer, N. Mag. Bot., i., p. 91 (1794). Plasmodium? Total height 1·5 to 2 mm. Sporangia subglobose or turbinate, scattered, stipitate, erect, 0·6 to 0·7 mm. diam., rufous-brown; cup one-third the height of the sporangium, with a regularly toothed margin, more or less ribbed, the thicker ribs continued into the wide-meshed net; the plasmodic granules of the sporangium-wall hardly 1 μ diam.; nodes of the net hardly expanded, or narrow triangular, flattened, connected by three or four firm threads. Stalk cylindrical, the length of the sporangium or more, 0·2 mm. thick, longitudinally rugose, black. Spores pale

yellowish-red, minutely warted, 5 to 7 μ diam.—Pers., Syn Fung., p. 193. *Stemonitis rufa* Roth, Fl. Germ., i., p. 548 (1788) *Cribraria rufa* Rost., Mon., p. 232 (1875); Cooke, Myx. Brit. p. 58; Blytt, Bidr. K. Norg., Sop. iii., p. 9; Mass., Mon., p. 63 *Cribraria intermedia* Schrad., Nov. Gen. Pl., p. 4 (1797). *C. fulva* Schrad., *l.c.*, p. 5.

Plate LIII., A.—*a.* sporangia, × 20; *b.* net and cup of sporangium-wall, × 50; *c.* spore and plasmodic granules, × 600 (Scotland).

Hab. On dead wood.—Moffat, Scotland (L:B.M.106); Baden Baden, Germany (L:B.M.106).

4. **C. minutissima** Schwein., in Trans. Am. Phil. Soc., New Series, iv., p. 260 (1834). Plasmodium? Total height 0·5 to 0·7 mm. Sporangia globose, gregarious, stipitate, erect or inclined, 0·1 to 0·2 mm. diam., nut-brown; cup half the height of the sporangium, or more, or less, or wanting, pale nut-brown, nearly even at the margin, faintly striate longitudinally with lines of plasmodic granules 1 μ diam; nodes of the net hardly expanded, or narrow and flattened, connected by three to five delicate threads. Stalk filiform, one and a half to four times the height of the sporangium, brown. Spores ochraceous, almost smooth, 5 to 6·5 μ.—Rost., Mon., App., p. 31. *Cribraria minima* Berk. & Curt., in Grev., ii., p. 67; Mass., Mon., p. 59. *C. microscopica* Berk. & Curt., in Grev., ii., p. 67; Rost., Mon., App., p. 31; Mass., Mon, p. 62.

Plate LIII., A.—*d.* to *g.* sporangia after dispersion of spores; *h.* spore and plasmodic granules, × 600 (United States).

In the large gatherings obtained by Dr. Rex of this species, great variety is found in the size of the cup and in the extent to which nodes of the net are enlarged. Nothing now remains in this country of the type specimen of *C. microscopica* Berk. & Curt.; but from Berkeley's description and figure it differs from *C. minutissima* only in having the nodes of the net rather more expanded, a character so variable that the organism is here included under *C. minutissima*.

Hab. On dead wood.—Philadelphia (L:B.M.107); S. Carolina (B. M. 671).

5. **C. macrocarpa** Schrad., Nov. Gen. Pl., p. 8 (1797). Plasmodium? Total height 2 mm. Sporangia globose or turbinate, gregarious or scattered, stipitate, erect, 0·6 to 0·8 mm. diam., rufous-brown; cup about one-third of the sporangium, orange-brown, with numerous dark longitudinal ribs, perforated above, margin irregularly and deeply toothed, merging into the branching nodes of the net; nodes flattened, elongated, confluent and irregular in the lower part, branching and polygonal, with the angles continued into the connecting threads above; the nodes and ribs of the cup beset with dark plasmodic granules 1 to 2 μ diam. Stalk cylindrical, 0·8 to 1 mm. high, 0·1 mm. thick, furrowed, dark brown. Spores ochraceous, nearly smooth, 4 to 6 μ diam.—Rost., Mon., p. 238; Cooke, Myx. Brit., p. 59; Blytt, Bidr. K. Norg., Sop. iii., p. 10; Mass., Mon., p. 56.

Plate LIII., B.—*a.* sporangia after dispersion of spores, × 20; *b.* part of net and cup of sporangium, × 50 (Freiburg, Germany: Rostafinski's type); *c.* net and cup of sporangium, × 50 (Black Forest, Germany); *d.* spore, and plasmodic granules, × 600.

Specimens from America from low elevations have usually more numerous and delicate connecting threads, and more prominent nodes in the upper part of the net; they approach forms of *C. intricata*, while the European type is coarser and more nearly resembles bold forms of *C. aurantiaca*. A gathering made by Dr. Rex at an elevation of 6,200 feet on Roan Mount, N. Carolina, exactly corresponds with Rostafinski's type in the Strassburg collection..

Hab. On dead fir-wood.—Baden Baden (L:B.M.108); Germany (Strassb. Herb.); Geneva (K. 1679); Norway (L:B.M.108 *slide*); New York (L:B.M.108); N. Carolina (L:B.M.108).

Heterodictyon Bieniaszii Racib., in Hedw., xxviii., p. 121 (1889). Sporangia solitary; stalk 1·5 to 2·5 mm. high, furrowed, thick below, narrowed upward; sporangia globose, brown, 0·8 to 1 mm. broad; cup one-third the height of the sporangium, bright brown, with net-like granular thickenings on the inner side as in *C. argillacea*; net dense with thickened nodes 3 to 4 angled, with concave sides, united with one another by thin connecting strands; the upper edge of the cup toothed, the teeth running into long linear parallel ribs as in *Dictydium*, which are bound together by thin horizontal threads; the ribs are 30 to 40 in a sporangium, and lose themselves at the summit in a *Cribraria*-like net with 3 to 6 angled concave-sided knots and ray-like connecting threads; spores bright yellow, smooth, 5 to 7 mm. diam.

Hab. On dead trunks in the Zoological Gardens of Tenczynek, Galicia.

This description suggests *Cribraria macrocarpa.*

6. **C. aurantiaca** Schrad., Nov. Gen. Pl., p. 5 (1797). Plasmodium sap-green. Total height 1 to 2 mm. Sporangia globose, gregarious, stipitate, erect or nodding, 0·4 to 0·7 mm. diam., nut-brown; cup one-third the height of the sporangium, irregularly and deeply toothed at the margin, beset with round plasmodic granules 0·5 to 1 μ diam., arranged in close lines radiating from the base of the sporangium; nodes of the net flattened, broad, or narrow, branching, angular, the angles continued into the delicate connecting threads, and often into a few free rays. Stalk subulate, dark brown, two to four times the height of the sporangium. Spores golden-yellow or ochraceous, smooth, 5 to 6 μ diam.—Rost., Mon., p. 233; Cooke, Myx. Brit., p. 58; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 10; Mass., Mon., p. 57. *Cribraria vulgaris* Schrad., *l.c.*, p. 6; Rost., Mon., p. 234; Cooke, Myx., Brit., fig. 26; Mass., Mon., p. 61. *C. vulgaris* var. *aurantiaca* Pers., Syn. Fung., p. 194.

α. Stalk one and a half times the height of the sporangium; nodes broad, polygonal.

β. Stalk two to four times the height of the sporangium; nodes triangular, narrow.

Plate LIV., A.—*a.* to *c.* sporangia of various forms, with spores dispersed, × 20; *d.* part of net and margin of cup of sporangium, var. *α*, × 180; *e.* part of net and margin of cup, var. *β*, × 180; *f.* spores and plasmodic granules, × 600 (England).

Rostafinski's specimens of *C. vulgaris* in Strassb. Herb., differ in no respect from his types of *C. aurantiaca*. In describing three forms of the first-named species, "*a. genuina*, *β. aurantioides*, *γ. delicatula*," he recognises the great variability to which it is subject, and points out how closely his form *β* approaches *C. aurantiaca*. Gatherings of this species at Lyme Regis, from the same fir logs, in consecutive years, show variations in the cup, net, and colour, which illustrate the characters given in Rostafinski's description and figures of both *C. aurantiaca* and *C. vulgaris*; it would therefore appear necessary to place the latter name as a synonym for the wide species *C. aurantiaca*.

Hab. On dead fir-wood.—Lyme Regis, Dorset (L:B.M.109); Luton, Beds (L:B.M.109); Glamis, Scotland (B. M. 246, 247); France (Paris Herb.); Germany (B. M. 673, 674); Poland (Strassb. Herb.); Philadelphia (L:B.M.109).

7. **C. splendens** Pers., Syn. Fung., p. 191 (1801). Plasmodium? Total height 1·5 mm. Sporangia globose, stipitate, erect or inclined, scattered, 0·3 mm. diam., nut-brown; sporangium-wall consisting in the lower half of about nine free ribs with little trace of a persistent cup, continued into a loose net with narrow, somewhat triangular nodes. Stalk slender, brown, four or five times the length of the sporangium. Spores pale ochre, almost smooth, 5 *μ* diam.—Rost., Mon., p. 236; Mass., Mon., p. 64. *Dictydium splendens* Schrad., Nov. Gen. Pl., p. 14 (1797).

Plate LIII., B.—*e.* sporangia after dispersion of spores, × 50; *f.* part of net of sporangium, × 180; *g.* spore and plasmodic granules, × 600 (Germany: Rostafinski's type).

The description given above is drawn from the specimen from the Feldberg near Freiberg, in Strassb. Herb., referred to by Rostafinski, *l.c.* It differs from *C. aurantiaca*, *β*, in the strong ribs taking the place of a hemispherical cup; in one sporangium the ribs branch into a broad net from the apex of the stalk. The persistent membranous wall mentioned by Rostafinski has almost disappeared in this somewhat injured specimen; but as the permanence of the membrane is met with occasionally in nearly every species of *Cribraria*, the character is not of great value.

Hab. On dead fir-wood.—Feldberg, Germany (Strassb. Herb.; L:B.M.110 *slide*).

8. **C. intricata** Schrad., Nov. Gen. Pl., p. 7 (1797). Plasmodium? Total height 1·5 to 3 mm. Sporangia globose, stipitate, nodding or erect, gregarious, 0·5 to 0·7 mm. diam., ochraceous-brown; cup one-third the height of the sporangium, or wanting, yellow-brown, beset with brown plasmodic granules 0·5 to 2 *μ* diam., arranged in close lines radiating from the base of the sporangium; margin more or less irregularly toothed; net close, regular; nodes numerous, dark brown, thickened, prominent, polygonal, often branching, with many free rays, and

connected by very slender more or less parallel threads. Stalk subulate, two to four times the height of the sporangium, dark brown. Spores ochraceous, nearly smooth or faintly warted, 5 to 6 μ diam.—Rost., Mon., p. 237; Cooke, Myx. Brit., p. 59; Mass., Mon., p. 59; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 119. *Cribraria dictydioides* Cooke & Balf., in Rav. Fung. Amer., p. 475; Mass., Mon., p. 65. *C. Balfourii* de Bary, in Herb.

a. **genuina**: cup about one-third the height of the sporangium.

β. **dictydioides**: cup almost or quite obsolete; the nodes in the lower part of the net elongated and confluent, forming ribs converging to the apex of the stalk.

Plate LIV., B.—*a*, *b*. sporangia after dispersion of spores, *a. genuina*, × 20; *c*. part of net and cup of sporangium, × 180 (Borneo); *d*. sporangium after dispersion of spores, *β. dictydioides*, × 20 (S. Carolina, U.S.A.: type of *C. dictydioides* Cooke & Balf.); *e*. spore and plasmodic granules, × 600.

The specimens in the Strassburg and Kew Herbaria (K. 963, 1673) named *Cribraria Balfourii* de Bary, on Sphagnum from the hot stoves of the Royal Botanic Gardens, Edinburgh, are small developments of *β. dictydioides*. Nearly similar forms have been obtained in orchid-houses at Lamberhurst, Kent.

Hab. On dead wood.—*β.* Bristol (L:B.M.111 *slide*); *β.* hot stove R. Bot. Gardens, Edinburgh (L:B.M.111); *β.* Java (B. M. 1107); *a.* Borneo (L:B.M.111); *a.* and *β.* Philadelphia (L:B.M.111); *a.* S. Carolina (B. M. 677); *β.* S. Carolina (B. M. 680, 681, 940).

9. **C. tenella** Schrad., Nov. Gen. Pl., p. 6 (1797). This species resembles *C. intricata* in size, shape, colour, and spores. Cup one-third the height of the sporangium, or more or less obsolete. Net close, regular; nodes numerous, dark brown, rounded, rarely elongated, prominent, with few or no free rays, connected by three to six very slender threads.—Rost., Mon., p. 235; Mass., Mon., p. 58. *C. elata* Mass., Mon., p. 61.

Plate LIV., B.—*f*. sporangium after dispersion of spores, × 20; *g*. part of net of sporangium, × 180 (Ceylon: Rostafinski's type); *h*. part of net and margin of cup, × 180 (Philadelphia, U.S.A.); *i*. spore and plasmodic granules, × 600.

Both *C. tenella* and *C. intricata* are abundant in the United States, where frequent intermediate forms occur connecting them with one another. The specimen figured from Ceylon (K. 1684), referred to by Rostafinski, Mon., App., p. 31, as a type of *C. tenella*, has a small cup, rounded or elongated prominent nodes, with no free rays; it is similar to the specimens received from Dr. Rex from the United States under that name. Mr. Massee has raised it to the rank of a species as *C. elata*.

Hab. On dead wood.—Orchid house, Lamberhurst, Kent (L:B.M.112); Ceylon (K. 1684); Philadelphia (L:B.M.112); N. Carolina (L:B.M.112).

10. **C. pyriformis** Schrad., Nov. Gen. Pl., p. 4 (1797). Plasmodium? Total height 1 to 1·7 mm. Sporangia turbinate or globose, stipitate, erect, gregarious, 0·3 to 0·5 mm. diam., purplish-brown; cup about one-third the height of the sporangium, pale brownish-yellow, perforated and irregularly toothed at the margin, or equally toothed, beset with large round purple-brown plasmodic granules, 2 to 2·5 μ diam., arranged in broad lines radiating from the base or evenly distributed; nodes of the net varying in shape and size, charged with dark round plasmodic granules and connected by pale brownish-yellow threads. Stalk stout or slender, 0·5 to 1 mm. high, dark purple-brown. Spores pale ochraceous or pinkish, almost smooth, 5 to 6 μ diam.—Rost., Mon., p. 237; Cooke, Myx. Brit., fig. 14; Mass., Mon., p. 55.

α. **genuina**: sporangia pyriform; nodes flat, polygonal, often branching; stalks stout, furrowed.

β. **notabilis**: (Rex, in litt.) sporangia globose; nodes convex and prominent, rounded or irregular; stalks slender.

Plate LV., A.—*a.* sporangia after dispersion of spores, *α. genuina*, × 20; *b.* part of net and cup of sporangium, × 180 (Shrewsbury, England); *c.* sporangium from mounting in Canada balsam, × 20 (Germany, Rostafinski's type); *d.* part of net and cup of same, × 180; *e.* sporangia after dispersion of spores, *β. notabilis*, × 20; *f. g.* part of net and cup of brown and dark-brown sporangia, × 180; *h.* spore and plasmodic granules, × 600 (United States).

The variety *β. notabilis* appears to be the American form of *C. pyriformis*; it differs from the European gatherings in the globose sporangia, the slender stalks, the delicate threads of the net, and in the nodes, which, though variable in shape, are usually prominent and convex, often approaching forms of *C. tenella* and *C. intricata*. It has been obtained from several of the American States. The abundance of plasmodic granules varies in different gatherings.

Hab. On dead fir-wood.—*α.* France (Paris Herb.); *α.* Berlin (B. M. 672); *α.* Germany (Strassb. Herb.); *β.* New York (L:B.M.113); Virginia (L:B.M.113); N. Carolina (L:B.M.113).

11. **C. languescens** Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 394. Plasmodium? Total height 2·5 to 3 mm. Sporangia globose, stipitate, drooping, scattered, 0·25 to 0·35 mm. diam., dull red; cup one-third the height of the sporangium, red-brown, shining; beset with purple-brown plasmodic granules, 0·3 to 1 μ diam., arranged in close lines radiating from the apex of the stem; margin toothed; nodes of the net purplish-brown, thickened, rather prominent, charged with dark granules, polygonal, with few free rays, and slender connecting threads; meshes of the net triangular. Stalk very slender, subulate, somewhat sinuous or wavy, dark red-brown. Spores pale red, almost smooth, 5 to 6·5 μ diam.

Plate LV., B.—*a.* sporangia after dispersion of spores, × 20; *b.* part of net and margin of cup of sporangium, × 180; *c.* spore and plasmodic granules, × 600 (United States).

This species has hitherto been found only in America; the spores in mass are described by Dr. Rex as "dull red, the colour of the paler forms of *C. purpurea*."

Hab. On dead wood.—New York (L:B.M.114); Ohio (L:B.M.114); S. Carolina (K. 1689).

12. **C. microcarpa** Pers., Syn., p. 190 (1801). Plasmodium? Total height 0·7 to 2 mm. Sporangia globose, gregarious, stipitate, erect or nodding, 0·2 to 0·25 mm. diam., purple-brown; cup rudimentary or wanting; net close, regular; nodes of the net subglobose, prominent, about 10 μ diam., densely charged with purple-brown plasmodic granules 1 to 2 μ diam., connected by five or six delicate pink threads. Stalk slender, four to ten times the height of the sporangium, purple-brown. Spores pale red, minutely spinulose, 5 to 6 μ diam.—Rost., Mon., p. 235; Mass., Mon., p. 63. *Cribraria capillaris* Fr., Stirp. Femsj., p. 84. *Dictydium microcarpum* Schrad., Nov. Gen. Pl. p. 13 (1797).

Plate LV., B.—*d*, *e*. sporangia after dispersion of spores, × 20 (*d*. Germany, Rostafinski's type, *e*. United States); *f*. part of net with cup of sporangium, × 180 (Germany); *g*. the same, × 180 (United States); *h*. spore and plasmodic granules, × 600.

Hab. On rotten wood.—Germany (B. M. 676); Freiburg, Germany (Strassb. Herb.); Philadelphia (L:B.M.115).

13. **C. purpurea** Schrad., Nov. Gen. Pl., p. 8 (1797). Plasmodium? Total height 2·5 mm. Sporangia globose, stipitate, erect or inclined, gregarious, 1 mm. diam., purple; cup one-third of the sporangium, margin deeply toothed; net of slender threads with mesh of varying size, about 1 mm. diam., only a few of the nodes expanded, flat, and angular; the cup and net thickly studded with round purple plasmodic granules, 2 to 2·5 μ diam. Stalk cylindrical, furrowed, 1·5 mm. long, 0·1 mm. thick, purple-black. Spores purplish, minutely warted, 5 to 6 μ diam.—Rost., Mon., p. 233; Blytt, Bidr. K. Norg., Sop. iii., p. 10; Mass., Mon., p. 57.

Plate LVI., A.—*a*. sporangium after dispersion of spores, × 20; *b*. part of net of same, × 180; *c*. spore and plasmodic granules, × 600 (Salzburg, Tyrol).

Hab. On rotten wood.—Salzburg, Tyrol (L:B.M.116); Norway (L:B.M.116 *slide*); Philadelphia (L:B.M.116).

14. **C. elegans**, Berk. & Curt., in Grev., ii., p. 67 (1873). Plasmodium? Total height 0·7 to 1·3 mm. Sporangium globose, stipitate, erect or inclined, gregarious, 0·3 to 0·4 mm. diam., red-purple; cup about half the height of the sporangium, with the margin deeply toothed and perforated; net of very slender threads, with numerous branching flat expansions at the nodes, the cup and nodes thickly studded with round purple plasmodic granules, 2 to 2·5 μ diam. Stalk subulate, nearly smooth, 0·6 to 1 mm. long, purple-black. Spores pale violet, almost smooth, 4 to 6 μ diam.—Rost., Mon., App., p. 31; Mass., Mon., p. 55.

Plate LVI., A.—*d.* sporangia after dispersion of spores, × 20; *e.* part of net and margin of cup, × 180; *f.* spore and plasmodic granules, × 600 (United States).

This species is nearly allied to *C. purpurea*.

Hab. On rotten wood.—New York (L:B.M.117); S. Carolina (B. M. 675, 941).

15. **C. violacea** Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 393. Plasmodium "deep violet-black, in rotten wood" (Rex, *l.c.*). Total height 0·5 to 1 mm. Sporangia globose or ellipsoid, stipitate, erect or slightly nodding, gregarious, about 0·2 mm. diam., dark violet with a metallic sheen; cup varying in extent of development, two-thirds the height of the sporangium or more, or reduced to one-third, membranous, violet-blue, the margin scalloped with few short teeth; net of delicate threads connected with broadly expanded, flat, angular nodes; "exceptionally the apical portion is nearly entire, being simply perforated with three or four oval or rounded openings" (Rex). The cup and nodes are beset with minute purple plasmodic granules 0·5 to 1 μ diam. Stalk slender, subulate 3 to 5 mm. long, violet-black. Spores lilac, minutely and closely warted, 6 to 8 μ diam.

Plate LVI., A.—*g.* sporangium after dispersion of spores, × 20 (England); *h.* part of net and margin of cup of same, × 180; *i.* sporangia after dispersion of spores, × 20 (United States); *k.* part of net and cup of same, × 180; spore and plasmodic granules, × 600.

In July, 1893, and in September, 1894, fine gatherings of this beautiful and minute species were obtained by Mr. J. Saunders from the under side of a rotten fir-log near Ivinghoe, Bucks; the colour of the sporangia, stalks and spores is violet-blue, and they resemble the American specimens received from Dr. Rex in all respects except that in many cases the cup of the sporangium-wall is one-third to one-half the height of the sporangium instead of two-thirds or more. It differs from *C. elegans* in the longer stalks, the smaller sporangia, in the blue-, not red-purple colour, in the smaller plasmodic granules in the knots and sporangium-wall, and in the larger violet-blue spores with a thicker epispore.

Hab. On fir-wood.—Ivinghoe, Bucks (L:B.M.118); Philadelphia (L:B.M.118).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

16. **C. tatrica** Racib., in Hedw. (1885), p. 170. Sporangia globose, red-brown, $\frac{3}{4}$ to 1 mm. diam., stalked; stalk dull red, straight, 2 mm. long; cup irregularly crenate-dentate, closely perforated at the margin; nodes of the net not enlarged; spores smooth, yellow, 6 to 7 μ diam.

Hab. On rotten wood.—Tatra, Hungary.

This description suggests *C. aurantiaca* β., in which the nodes of the net are only slightly enlarged.

C. stellata Schum., *C. didermoides* Schum., *C. badia* Chev., are excluded by Rostafinski on what appear to be sufficient grounds.

SPECIES EXCLUDED FROM THE GENUS.

C. mirabilis Mass. = *Dictydium umbilicatum* Schrad.
C. exilis Macbride = *Dictydium umbilicatum* Schrad.

Genus 24.—**DICTYDIUM** Schrader, Nov. Gen. Pl., p. 11 (1797). Sporangia globose, stipitate; sporangium-wall formed of parallel ribs extending from the base to the apex, connected by slender transverse threads, the intervening wall evanescent.

1. **D. umbilicatum** Schrad., *l.c.*, p. 11 (1797). Plasmodium purple. Total height 1 to 2 mm. Sporangia globose, cernuous, 0·5 to 0·7 mm. diam., dark red-brown; sporangium-wall forming a net with nearly square meshes, composed of numerous rigid longitudinal ribs 5 μ thick, connected by delicate transverse threads; basal cup scarcely developed. Stalk subulate, bent or twisted at the slender apex, rich purple-brown, one to three times the length of the sporangium. Spores pale red, minutely warted, 4 to 7 μ diam., usually with two to four purple plasmodic granules on the spore wall.—Fr., Syst. Myc., iii., p. 165. *Mucor cancellatus* Batsch, El. Fung., ii., 137 (1786). *Stemonitis cancellata* Gmel., Syst. Nat., p. 1468. *Cribraria cernua* Pers., Obs. Myc., i., p. 91 (1796). *Dictydium cernuum* Nees, Syst. Pilze., p. 120 (1816); Rost., Mon., p. 229; Cooke, Myx. Brit., p. 57; Blytt, Bidr. K. Norg., Sop. iii., p. 9; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 118. *Heterodictyon mirabile* Rost., Mon., p. 231. *Cribraria mirabilis* Mass., Mon., p. 60. *C. exilis* Macbride, in Bull. Nat. Hist. Iowa, ii., p. 378.

Plate LVI., B.—*a.* to *d.* sporangia of various forms after the dispersion of the spores, × 36; *a.* typical form; *b.* form with cup; *c.* form with irregular net, found with sporangia of usual type (England); *d.* erect sporangium (United States); *e.* spore, × 600; *f.*, *g.* type of *Heterodictyon mirabile* Rost., × 70 (Freiburg, Germany); *h.* spores of same, × 600.

The ribs of the sporangium-wall are inflexed at the summit in maturity, and break the ball of enclosed spores by vertical pressure; they consist of two layers, the outer smooth and shining, the inner beset with purple plasmodic granules 1 μ diam.; they are usually free at the base of the sporangium, but are sometimes connected by an irregular basal disc. A form is occasionally found with a well-developed cup having an evenly toothed margin from which the ribs take rise; associated with this character the stalk is more erect, and of a browner colour than in the usual type; the variety, however, appears to be too inconstant to be marked as distinct. A careful examination of the type specimen of *Heterodictyon mirabile* Rost., in the Strassb. Herb., leads to the conclusion that it is a form of *Dictydium umbilicatum*. It is no doubt a remarkable development; the basal cup is large and irregular, and the ribs in many parts are expanded and form a loose, imperfect net with broad and angular nodes; in other parts the ribs are connected by the usual delicate transverse threads, and though fewer in number and coarser than in the type, are essentially of the same character; they are thickly beset on the inner side with purple plasmodic granules, the cup is also studded with the same; the spores are precisely similar to those of

Dictydium umbilicatum, with two to four minute purple granules on the spore wall; the stalks are stout and rugged, but of the same purple-brown colour as in the latter species. The type of *Cribraria exilis* Macbride, from Nicaragua (B. M. 1026), is an almost typical form of *Dictydium umbilicatum*, with a shallow cup connecting the slender parallel ribs at the base.

Hab. On dead wood. — Lyme Regis, Dorset (L:B.M.119); Wanstead, Essex (L:B.M.119); Luton, Beds (L:B.M.119); Glamis, Scotland (B. M. 241); France (Paris Herb.); Germany (B. M. 660, 663); Italy (B. M. 659); Ceylon (B. M. 670); Borneo (L:B.M.119); Maine (B. M. 1105); Philadelphia (L:B.M. 119); Iowa (B. M. 821); S. Carolina (B. M. 666); Nicaragua (B. M. 1026).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **D. venosum** Schrad., Nov. Gen. Plant., p. 14, pl. iii., fig. 6 (1797). Scarcely a line high; sporangia spherical, cernuous, more or less as in *D. umbilicatum*, yellowish-brown, when the spores are shed, colourless; veined with nine to twelve ribs of rather a brighter colour, the final branches of the ribs lateral, usually not anastomosing; stalk slender, flexuose, brownish.

Hab. On rotten pine wood.

Possibly a form of *D. umbilicatum*, with an irregular net.

Order II.—LICEACEÆ. Sporangia solitary, sessile or stalked; sporangium-wall cartilaginous; capillitium and columella wanting.

KEY TO THE GENERA OF *LICEACEÆ*.

Sporangia sessile, globose or plasmodiocarps. (25) LICEA.

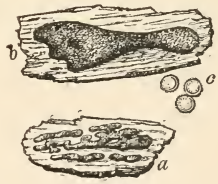

Fig. 33.—*Licea flexuosa* Pers.
a. Group of plasmodiocarps. Twice natural size.
b. Plasmodiocarp. Magnified 6 times.
c. Spores. Magnified 200 times.

Fig. 33.

Sporangia stalked, furnished with a lid of thinner substance. (26) ORCADELLA.

Fig. 34.—*Orcadella operculata* Wingate.
a. Group of sporangia. Magnified 8 times.
b. Sporangium with open lid. Magnified 80 times.

Fig 34.

Genus 25.—**LICEA** Schrader, Nov. Gen. Pl., p. 16 (1797). Sporangia sessile; sporangium-wall cartilaginous dark brown; spores olive brown.

KEY TO THE SPECIES OF *LICEA*.

A. Spores spinulose:—

Sporangia forming elongate plasmodiocarps, spores 11 to 14 μ. 1. *L. flexuosa*

Sporangia subglobose, spores 9 to 11 μ. 2. *L. minima*

B. Spores smooth, 16 to 20 μ. 3. *L. pusilla*

1. **L. flexuosa** Pers., Syn. Fung., p. 197 (1801). Plasmodium dull yellow. Sporangia pulvinate depressed, or forming elongated plasmodiocarps, scattered, 2 to 4 mm. long, opaque, dark brown, dehiscing irregularly; sporangium-wall of two closely combined layers, the outer opaque from granular deposits of refuse matter, the inner cartilaginous, translucent, olive-brown. Spores pale olive-brown, spinulose, 11 to 14 μ diam.—Rost., Mon., p. 218. *Tubulina flexuosa* Poiret, Ency. Meth., vol. viii., p. 131 (1808); Mass., Mon., p. 37.

Plate LVII., A.—*a*. plasmodiocarp, × 20; *b*. fragment of sporangium-wall and spores, × 280; *c*. spore, × 600 (Germany).

The spores in this species are free, and thicker and rougher on one side. There is a specimen from Capt. Carmichael, Appin, Argyle (K. 1670), named by Berkeley *Licea flexuosa*, and by Rostafinski *Enteridium olivaceum* (Mon., App., p. 30), which is a simple plasmodiocarp form without capillitium, resembling *L. flexuosa*, but the spores are in clusters of 6 to 8; it holds an intermediate position between the two species, which appear to be closely allied; specimens of typical æthalioid *Enteridium olivaceum* are occasionally found having free spores.

Hab. On dead wood.—Aboyne, Scotland (K. 1644); Germany (Strassb. Herb.; L:B.M.120); Norway (L:B.M.120).

2. **L. minima** Fr., Syst. Myc., iii., p. 199 (1829). Plasmodium yellow (teste Rex). Sporangia hemispherical on a broad base, depressed, scattered, 0·2 to 0·5 mm. diam., brown or nearly black, dehiscing in lobes; sporangium-wall cartilaginous, opaque, dark brown, the margin of the lobes dotted with minute granules 1 to 2 μ diam. Spores olivaceous-brown, thicker on one side, spinulose, 9 to 11 μ diam.—*Tubulina minima* Mass., Mon., p. 36.

Plate LVII., A.—*d*. sporangia, × 20; *e*. spores, × 280 (Finland); *f*. spores, × 280 (Sweden); *g*. sporangia, × 20 (United States); *h*. fragment of sporangium-wall and spores of same, × 280; *i*. spore, × 600.

Hab. On dead pine-wood.—Finland (B. M. 654); Sweden (K. 1646); Norway (L:B.M.121); New York (L:B.M.121).

3. **L. pusilla** Schrad., Nov. Gen. Pl., p. 19 (1797). Plasmodium? Sporangia hemispherical or pulvinate, scattered, 0·6 to 1 mm. diam., dark brown, glossy, dehiscing in lobes; sporangium-wall cartilaginous, olive-brown, the margin of the lobes dotted with minute granules, 1 to 2 μ diam. Spores olive-brown, smooth, 16 to 20 μ diam.—*Protoderma pusilla* Rost., Mon., p. 90. *Protodermium pusillum* Berl., in Sacc., Syll., vii., p. 328; Mass., Mon., p. 43.

Plate LVII., B.—*a*. sporangia, × 20; *b*. fragment of sporangium-wall, and spores, × 280; *c*. spore, × 600 (Scotland).

This species was separated by Rostafinski from *Licea*, and placed in the division *Amaurosporeæ* as the type of a new genus *Protoderma*, on account of the colour of the spores. The examination of several specimens in Strassb. Herb. and British Museum shows that the colour of the spores is essentially olive-brown; Schrader's original place for the species is therefore retained.

Hab. On dead wood.—Glamis, Scotland (B. M. 100); Kiel, Germany (Strassb. Herb.).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

4. **L. variabilis** Schrad., Nov. Gen. Pl., p. 18, pl. 6, figs. 5, 6. Sporangia scattered, depressed, reddish-brown, hemispherical, ovate, oblong or flexuose, of varying shape and size; sporangium-wall thin, dehiscing above, composed of a double membrane, the outer rough, the inner smooth, shining; spores dull yellow.

Hab. On pine-wood, rarely on beech.

The description and figures suggest that this species was a form of *Perichæna populina* Fr., with scanty or no capillitium.

5. **L. brunnea** Preuss, Linnea, xxvi., p. 709 (1853). Sporangia gregarious, globose, subdepressed, ochraceous-brown; the wall parchment-like, breaking irregularly, evanescent above; spores minute, ochraceous, conglobate; capillitium none.

Hab. On pine-wood.—Hoyerswerda, Silesia.

This brief description probably refers to *Cribraria argillacea* Pers.

6. **L. incarnata** Preuss, *l.c.* (1853). Sporangia minute, flesh-coloured, smooth, round, somewhat depressed; spores flesh-coloured, globose.

Hab. On dried tincture of rhubarb.—Hoyerswerda, Silesia.

This description is too imperfect to be of value.

7. **L. antarctica** Speg., in Boletin Acad. Nac. Cienc. Cord. Arg., xi., p. 5. Sporangia in groups of from 5 to 20, rarely solitary, sessile, obovate, 0·5 to 0·7 mm. diam., smoke-brown, glabrous, smooth; wall simple, brown, rugulose; capillitium very scanty of slender, scarcely branching, papillose tubes, 1 μ thick, dull yellow-brown; spores globose, closely and minutely warted, rosy-fulvous.

Hab. On dead trunks of *Fagus antarctica*.

The description suggests a form of *Perichæna populina* Fr.

SPECIES EXCLUDED FROM THE GENUS.

L. cæspitosa Peck. = *Lindbladia Tubulina* Fr.
L. Lindheimeri Berk. = *Fuligo septica* Gmel.
L. perreptans Berk. = *Brefeldia maxima* Rost.
L. rubiformis Berk. = *Tubulina fragiformis* Pers.
L. spermoides Berk. & Curt. = *Lindbladia Tubulina* Fr.

Genus 26.—**ORCADELLA** Wingate, in Proc. Acad. N. Sc. Phil. (1889), p. 280. Sporangia stipitate; sporangium-wall opaque, granular, except in the upper part, where it forms a membranous lid.

123. **Orcadella operculata** Wing., *l.c.* (1889). Plasmodium? Total height 0·4 to 0·7 mm. Sporangia urn-shaped or subglobose, stipitate, erect, scattered, 0·1 to 0·2 mm. diam., nearly black, lid flattened, circular, dull yellow, shining; sporangium-wall cartilaginous, opaque from deposits of refuse matter; lid membranous, beset with minute granules 0·5 to 1 μ diam. Stalk cylindrical, subulate, nearly black, filled with dark coarse refuse matter. Spores yellowish in mass, almost colourless and smooth, 8 to 11 μ diam.—Mass., Mon., p. 49.

Plate LVII., B.—*d.* sporangia, × 20; *e.* fragment of sporangium-wall and papillose lid, with spores, × 280; *f.* spore, × 600 (United States).

Hab. On dead wood.—Philadelphia (L:B.M.123).

Order III.—TUBULINACEÆ. Sporangia tubular, compacted, stalked or sessile; sporangium-wall membranous, pale rufous, without granular deposits: spores minutely reticulated, 4 to 7 μ diam.

KEY TO THE GENERA OF *TUBULINACEÆ*.

Sporangia without tubular extensions. (27) TUBULINA.

Fig. 35.—*Tubulina fragiformis* Pers. Cluster of sporangia. Magnified 2½ times.

Fig. 35.

Sporangium-wall with tubular extensions connecting it with a hollow pseudo-columella. (28) SIPHOPTYCHIUM.

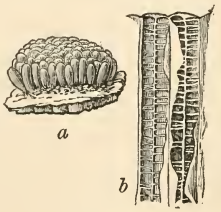

Fig. 36.—*Siphoptychium Casparyi* Rost.
a. Cluster of sporangia. Magnified 3 times.
b. Upper part of two sporangia, their walls partially removed, showing the columella. Magnified 10 times.

Fig. 36.

Sporangium-wall with tubular extensions springing from the apex, without a pseudo-columella; sporangia stalked.

(29) ALWISIA.

Fig. 37.—*Alwisia Bombarda* Berk. & Br.

a. Three clusters of sporangia. Twice natural size.

b. Immature sporangium, showing capillitium through the transparent walls. (Drawn from a glycerine mounting.) Magnified 12 times.

c. Upper portion of three capillitium threads, showing attachment to the sporangium-wall. Magnified 70 times.

Fig. 37.

Genus 27.—**TUBULINA** Persoon, in Röm. N. Mag. Bot., i. p. 91 (1794). Sporangia cylindrical, crowded on a common hypothallus; capillitium none.

KEY TO THE SPECIES OF *TUBULINA*.

Sporangia clustered on a broad hypothallus, spores 5 to 8 μ. 1. *T. fragiformis*

Sporangia clustered on a stalk-like hypothallus, spores 3 to 5 μ. 2. *T. stipitata*

1. **T. fragiformis** Pers., *l.c.* (1794). Plasmodium watery-white, in rotten wood. Sporangia cylindrical, angled, convex above, 3 mm. long, 0·4 mm. broad, densely crowded on a common spongy hypothallus forming a honeycomb-like rufous-brown mass, 2 to 7 cm. in breadth; sporangium-wall membranous, pale rufous-brown. Spores pale rufous-brown, minutely reticulated over the greater part of the surface, the remaining part smooth, or marked with broken ridges, 5 to 8 μ diam.—Lam. & DC., Syn. Pl., p. 52 (1806). *Sphærocarpus cylindricus* Bull., Champ., Pl. 470, fig. 3. *Tubulina cylindrica* Lam. & DC., Syn. Pl., p. 52 (1806); Rost., Mon., p. 220; Cooke, Myx. Brit., p. 54; Blytt, Bidr. K. Norg., Sop. iii., p. 9; Rex, in Bot. Gaz., xv., p. 315; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 114; Mass., Mon., p. 39. *T. nitidissima* Berk., Journ. Linn. Soc., xviii., p 387. *Licea rubiformis* Berk. & Curt., Fung. N. Pac., in Proc. Amer. Acad. Art and Sci. (1859), p. 125.

Plate LVIII., A.—*a*. tubular sporangia clustered on a spongy barren base, × 3; *b*. spores; in two the side is shown on which the reticulation is imperfect, × 600 (England); *c*. part of a cluster of sporangia with conical summits, × 3 (United States).

On examination of the sporangium-wall with a high magnifying power, it is seen to be more or less beset with minute papillæ; small pouches may also be occasionally observed extending inwards to a greater or less degree, which in some forms are produced into tubes

passing across the sporangium or taking an oblique course; this appearance indicates a tendency in the direction of the marked development of tubular processes in *Siphoptychium*. The substance of the sporangium-wall varies in different gatherings; it may be delicately membranous, or firm and of considerable thickness. There is also some variation in the shape of the upper portion of the sporangium; in some American specimens of the more fragile type the apex is produced into a sharp cone; in others the sporangia are cylindrical, obtuse, and but slightly connected with each other, those on the outside of the cluster being often entirely free; in the stouter type the walls are closely compacted, their apices forming a level tesselated surface.

A full account of the forms of *Tubulina* and their relation to *Siphoptychium* is given by Dr. Rex, *l.c.* *T. speciosa* Speg. (Nov. Add. ad Myc. Ven., No. 123), from N. Italy, appears from the description to be *T. fragiformis*, but no mention is made of the size of the spores.

Hab. On dead wood.—Bowood, Wilts (B. M. 302); Penzance, Cornwall (B. M. 303): Luton, Beds (L:B.M.124); Clifton, Nottinghamshire (B. M. 1103); Wales (B. M. 9, 10); France (Paris Herb.); Germany (B. M. 656); Poland (Strassb. Herb.); Finland (B. M. 655); India (K. 1650); Java (B. M. 1104); Japan (K. 1649); Java (B. M. 1104); Australia (K. 1653); Philadelphia (L:B.M.124); Iowa (B. M. 823); S. Carolina (K. 806).

2. **T. stipitata** Rost., Mon., p. 223 (1875). Plasmodium white or colourless (teste Rex). Sporangia in shape, size, and colour as in *T. fragiformis*, usually clustered on a dark brown spongy hypothallus, which has the form of a stout common stalk 2 to 3 mm. high. Spores pale rufous-brown, minutely reticulated over the greater part of the surface, the remaining part smooth or marked with ridges, 3 to 5 μ diam.—Cooke, Myx. Brit., fig. 2; Rex, in Bot. Gaz., xv., p. 318; Mass., Mon., p. 38. *Licea stipitata* Berk. & Rav., in Journ. Linn. Soc., x., p. 350 (1868).

Plate LVIII., A.—*d.* cluster of sporangia on a stalk-like base, × 3; *e.* spores; one shows the side on which the reticulation is imperfect, × 600 (United States).

Dr. Rex considers *T. stipitata* a distinct species from *T. fragiformis*, specially marked by the smaller spores. The stalk is a less important character, for he states that sessile clusters are not uncommon. The conical form supplied by him and referred to under *T. fragiformis* has spores measuring 4 to 6 μ, and may represent an intermediate form.

Hab. On dead wood.—Bonin Islands (K. 821); Philadelphia (L:B.M. 125); S. Carolina (B. M. 538, 929, 946); Cuba (B. M. 539).

SPECIES EXCLUDED FROM THE GENUS.

T. cæspitosa Mass. = *Lindbladia Tubulina* Fr.
T. effusa Mass. = *Lindbladia Tubulina* Fr.
T. flexuosa Mass. = *Licea flexuosa* Pers.
T. minima Mass. = *Licea minima* Fr.
T. spermoides Mass. = *Lindbladia Tubulina* Fr.

The type specimen of *Tubulina guaranitica* Mass. (Mon., p. 39), from Guarapi, Argentine Republic, does not belong to the Mycetozoa; it consists of stalked heads composed of a densely interwoven tissue of brown septate branching hyphæ, bearing numerous umber spores, 2 to 7 μ diam., in the upper part; it belongs to the *Hyphomycetes*. *Licea spumarioidea* Cooke & Mass., in Grev., xvi., p. 74,=*Tubulina spumarioidea* Mass., Mon., p. 42 (K. 801), is also a Hyphomycetous fungus, *Sepedonium chrysospermum* Link.

Genus 28.—**SIPHOPTYCHIUM** Rostafinski, Mon., App., p. 32 (1876). Sporangia cylindrical, closely compacted on a common hypothallus, provided with a central tubular columella connected with the sporangium-wall by straight radiating hollow processes.

1. **S. Casparyi** Rost., *l.c.* (1876). Plasmodium white, on rotten wood (teste Rex). Sporangia in shape, size, and colour as in *Tubulina fragiformis*, differing in being provided with the central columella described in the genus. Spores pale rufous-brown, closely reticulated over the greater part of the surface, loosely reticulated over the remaining part, 6 to 7 μ diam. Rex, in Bot. Gaz., vol. xv., p. 319; Mass., Mon., p. 89.

Plate LVIII., A.—*f.* portion of two sporangia with their walls partially broken away, showing the pseudo-columella and capillitium, × 20; *g.* portion of pseudo-columella and capillitium, × 80; *h.* spores; two show the side on which the reticulation is lax, × 600 (United States).

Dr. Rex is of opinion that the columella in *Siphoptychium* may be viewed as an aborted sporangium, and adds, "Æthalia are found in which from one-third to one-half of the component sporangia lack both columellas and connecting threads" (*l.c.*, p. 319).

The species has been found by Dr. Rex on the Adirondack Mountains, N.Y., in large quantity, but it is doubtful whether it has been obtained elsewhere. It is so nearly allied to *Tubulina fragiformis* that it is a question whether the presence of the pseudo-columella is a character of sufficient importance to justify a generic distinction.

Hab. On dead wood.—Adirondack Mts., N.Y. (L:B.M.26).

Genus 29.—**ALWISIA** Berkeley & Broome, in Journ. Linn. Soc., xiv., p. 86 (1873). Sporangia cylindrical, stipitate, the stalks combined in clusters; capillitium represented by tubular extensions of the sporangium-wall springing from the apex of the sporangium.

1. **A. Bombarda** Berk. & Br., *l.c.*, p. 87 (1873). Plasmodium? Total height 4 mm. Sporangia cylindrical-ellipsoid, stipitate, clustered, 1 to 1·5 mm. high, 0·5 mm. broad, rufous-brown; sporangium-wall membranous, pale red, beset with minute scattered papillæ on the inner side, and occasionally produced into small pouches. Stalks cylindrical, 2·5 mm. high, 0·12 mm. thick, closely adhering in clusters of 4 to 12, brownish-purple; when mounted in glycerine orange-red. Capillitium consisting

of numerous irregular, tubular threads, 0·5 to 1 mm. long, 3 to 18 μ wide at their origin at the apex of the sporangium, whence they radiate downwards, tapering and branching at a wide angle below, the slender extremities attached to the wall about halfway down the sporangium; pale red, beset with minute scattered papillæ. Spores pale red, closely reticulated over the greater part of the surface, the remaining part loosely reticulated, 5 to 6 μ diam.—Mass., in Journ. R. Micr. Soc. (1889), p. 349. *Trichia fragilis* Rost., Mon., App., p. 39 (in part). *Prototrichia Bombarda* Mass., Mon., p. 128.

Plate LVIII., B.—*a*. clusters of sporangia, × 2; *b*. cluster of sporangia, × 20; *c*. immature sporangia, from a mounting in glycerine, showing, through the walls, the capillitium threads arising from the apex of the sporangium, × 20; *d*. fragment of upper sporangium-wall, from which three capillitium threads proceed, only a small part of the thread shown, × 280; *e*. fragment of sporangium-wall to which the lower end of a branching capillitium thread is attached, × 280; *f*. spores, × 600 (Ceylon).

This species is represented by a single gathering in July 1868 by Thwaites from Ceylon. The sporangia are to a large extent immature, purplish, and with the spores imperfectly developed, but a few are nearly mature and show the rufous-brown colour described above. Although the character of the long clustered stalks is peculiar, the colour and texture of the sporangium-wall, and the colour, size, and markings of the spores are similar to what is seen in other members of the *Tubulineæ*, while the threads of the capillitium find a close analogy in the tubular extensions of the sporangium-wall of *Siphoptychium*.

Hab. On *Jungermannia*, growing on decayed wood.—Gongolla Forest, Ceylon (B. M. 1000).

Order IV.—Reticulariaceæ. Sporangia combined into an æthalium; sporangium-walls incomplete, perforated, or forming a spurious capillitium.

KEY TO THE GENERA OF *RETICULARIACEÆ*.

Sporangium-wall cap-shaped at the apex, continued down to the hypothallus in four to six straight threads.

(30) Dictydæthalium.

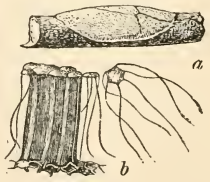

Fig. 38.—*Dictydiæthalium plumbeum* Rost.

a. Æthalium. Natural size.

b. Eight sporangia of an æthalium isolated; in three the column of spores has fallen away, leaving the cap and persistent threads. Magnified 20 times.

Walls of convoluted sporangia perforated and forming a uniform tissue of interarching bands.

(31) ENTERIDIUM.

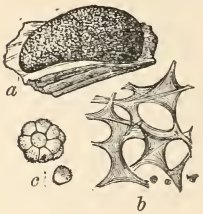

Fig. 39.

Fig. 39.—*Enteridium olivaceum* Ehrenb.

a. Plasmodiocarp. Magnified twice.
b. Part of spurious capillitium. Magnified 35 times.
c. A spore cluster, and one isolated spore. Magnified 210 times.

Walls of convoluted sporangia incomplete, forming tubes and folds with numerous anastomosing threads.

(32) RETICULARIA.

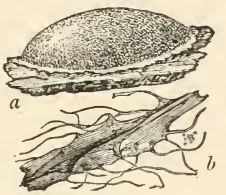

Fig. 40.

Fig. 40.—*Reticularia Lycoperdon* Bull.

a. Æthalium. Natural size.
b. Fragment of capillitium. Magnified 100 times.

Genus 30.—**DICTYDIÆTHALIUM** Rostafinski, Versuch, p. 5 (1873). Æthalium flat, formed of erect columnar sporangia; sporangium-wall dome-shaped at the apex, continued down to the hypothallus in four to six straight threads; capillitium none. *CLATHROPTYCHIUM* Rost., Mon., p. 225 (1875).

1. **D. plumbeum** Rost., *l.c.*, p. 5 (1873). Plasmodium rose-red, in rotten wood. Æthalium 1 to 3 cm. broad, 0·5 to 1 mm. thick, dull slate-coloured or clay-coloured, iridescent, areolated with the convex apices of the sporangia; sporangia cylindrical, angled by mutual pressure, 0·5 to 1 mm. high, 0·2 mm. thick; sporangium-wall persistent and dome-shaped at the apex, subcartilaginous, continued down to the hypothallus in four to six straight threads, 2 to 4 μ thick, triangular in section; evanescent between the threads. Spores clay-coloured or yellow in mass, when magnified pale yellow, spinulose, 9 to 12 μ diam.—*Fuligo plumbea* Schum., Enum. Pl. Saell., ii., p. 193 (1803). *Reticularia plumbea* Fr., Syst. Myc., iii., p. 88. *Licea rugulosa* Wallr., Comp. Fl. Germ., iv., p. 345 (1833). *Clathroptychium rugulosum* Rost., Mon., p. 225, App., p. 30; Cooke, Myx. Brit., p. 55; Blytt, Bidr. K. Norg., Sop. iii., p. 9; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 117; Mass., Mon., p. 51. *Licea applanata* Berk., in Hook., Journ. Bot.

(1845), p. 67. *Dictydiathalium applanatum* Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 69. *Reticularia entoxantha* Berk., in Hook., Journ. Bot. (1851), p. 201. *Clathroptychium Berkeleyi* Mass., Mon., p. 53.

Plate LXXVI., B.—*a.* part of an æthalium seen from above, × 20; *b.* tubular sporangia from an æthalium; in two of them the spores are dispersed and the caps and threads of the sporangium-walls are left free, × 20; *c.* sporangia from a stouter æthalium, × 20; *d.* cap and threads of sporangium-wall, × 50; *e.* hypothallus, areolated with the bases of the sporangia, × 50; *f.* spores and portion of a thread, × 280; *g.* spores and portion of thread from æthalium drawn at *c.* × 280 (England); *h.* spore and thread from a stout æthalium, × 280 (Sikkim, K. 1669); *i.* spore, × 600 (England); *k.* spore from type of *Clathroptychium Berkeleyi* Mass., × 600.

The spores are dispersed by the threads giving way at the base and the sporangia separating in tufts from the persistent shining hypothallus. American specimens have been received from Dr. Rex which show an abnormal development; the sporangium-wall is, to a great extent, continuous between the threads, and forms a lattice-work with wide expansions. An unusually stout form has been obtained from Sikkim (K. 1669), and named *Reticularia entoxantha* by Berkeley, but referred by Rostafinski to *Clathroptychium rugulosum*, *l.c.*; it is an olive-black æthalium, 3 mm. thick, and bright yellow within; the threads of the sporangia are 10 μ diam., waved and thickened at the margins; the spores are yellow and spinulose, 9 to 11 μ. *Clathroptychium Berkeleyi* Mass., from Ceylon (K. 1666), differs only from the robust forms of *D. plumbeum* in the more strongly spinulose spores; but as the spores of most gatherings vary in the amount of roughness, this character alone is not sufficient to mark specific difference. *Clathroptychium cinnabarinum* Sacc., in Michelia, i., p. 545, is said to have vermilion sporangia, with blackish-purple opercula and threads; this description applies to immature specimens of *D. plumbeum*.

Hab. On dead wood.—Rudloe, Wilts (B. M. 20); Batheaston, Somerset (B. M. 292, 299); Luton, Beds (L:B.M.128); France (Paris Herb.); Germany (Strassb. Herb.); Hungary (K. 828); Ceylon (K. 1664); Sikkim (K. 1669); Australia (K. 834); Philadelphia (L:B.M.128); New Jersey (B. M. 945); S. Carolina (B. M. 928, 947).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **D. dissiliens** Hazslinszky, in Oester. Bot. Zeitsch., xxvii., p. 85 (1877). Peridia pulvinate, round or oval, 2 to 5 mm. diam.; external wall chestnut-brown, dull pruinose; the inner wall, together with the spores and elaters, yellow-brown. Spores 8 to 10 μ.

Hab. On willow.—Hungary. The mature peridium bursts elastically, and the elaters then become three times longer.

Genus 31.—**ENTERIDIUM** Ehrenberg, in Spreng. Jahrb. Gewächs., I., ii., p. 55 (1818). Æthalium of confluent interwoven sporangia, their walls perforated with large openings; capillitium none.

KEY TO THE SPECIES OF *ENTERIDIUM.*

Spores warted, clustered.	*E. olivaceum*
Spores reticulated, free.	*E. Rozeanum*

1. **E. olivaceum** Ehrenb., *l.c.*, p. 57 (1818). Plasmodium rose-red, in dead wood. Æthalium pulvinate depressed, 1 to 3 cm. broad, 1 to 3 mm. thick, smooth or rugulose, dark olive-brown; sporangium-walls yellow-olive, subcartilaginous, perforated with wide openings forming a network with broad winged boundaries to the meshes. Spores in clusters of 6 to 20, rarely free, pale olive, thickened and warted on one side, 9 to 12 μ diam. —Rost., Mon., p. 227; Cooke, Myx. Brit., p. 56; Mass., Mon., p. 44. *Licæthalium olivaceum* Rost., Versuch, p. 4 (1873). *Reticularia applanata* Berk. & Br., Ann. Mag. Nat. Hist., Ser. 3, xviii., p. 56, t. ii., f. 3 (1866). *Enteridium simulans* Rost., Mon., App., p. 30.

Plate LIX., A.—*a.* æthalium, half natural size; *b.* perforated sporangium-walls, and spore clusters, × 80; *c.* spore cluster, × 600 (England).

Intermediate forms occur between *E. olivaceum* and *Licea flexuosa* (see note, p. 150), which indicate an alliance between the two species.

Hab. On dead wood.—Ascot, Berks (B. M. 14, 15, 16); Kent (B. M. 13); Boynton, Yorkshire (B. M. 1158); Glen Tanner, Scotland (K. 1670); Poland (Strassb. Herb.); New Jersey (K. 835).

2. **E. Rozeanum** Wing., in Proc. Ac. Nat. Sc. Phil. (1889), p. 156. Plasmodium? Sporangia hemispherical or subglobose, 5 to 30 mm. diam., red-brown; sporangium-walls within the æthalium perforated, forming a network of broad membranous bands, together with the spores red-brown. Spores reticulated on two-thirds of the surface, the remaining part faintly warted, 7 to 9 μ diam.—Macbride, in Bull. Nat. Hist. Iowa, vol. ii., p. 117; Mass., Mon., p. 46. *Reticularia* (?) *Rozeana* Rost., Mon., App., p. 33 (1876).

Plate LIX., A.—*d.* æthalium; half is seen in vertical section, showing the persistent sporangium-walls and the barren base, × 3; *e.* perforated sporangium-walls, × 80; *f.* spores, × 400 (United States).

Mr. Wingate states that specimens received by him from M. Roze, of Paris, identify the American gatherings with *Reticularia Rozeana* Rost.

Hab. Philadelphia (L:B.M.130); Ohio (L:B.M.130); Iowa (L:B.M. 130).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

3. **Enteridium Rostrupii** Raunk., in Bot. Tidssk, xvii., p. 106 (1888). Æthalium irregularly extended, 4 cm. broad, composed of one layer of sporangia, 1 mm. high; olive-green, the side walls of the sporangia perforated with large oval openings. Spores in

oval or spherical clusters of 5 to 25, warted on the exposed surface, elsewhere smooth, 11 to 12 μ.

Hab. On fir wood.—Denmark.

This appears to be a form of *E. olivaceum* intermediate between the usual type and the simple type from Glen Tanner referred to under *Licea flexuosa*.

4. **E. macrosperma** Raunk., *l.c.*, is described as similar to *E. olivaceum*, but the spores are spinulose on the outer surface and 12 to 14 μ diam.

Hab. On fir.—Denmark.

It is very doubtful if the slightly larger size and more spinulose markings of the spores is a sufficient character on which to base specific difference.

Genus 32.—**RETICULARIA** Bulliard, Champ., p. 95 (1791). Æthalium composed of numerous elongated interwoven sporangia, with their walls partly evanescent, partly persistent, forming chambers and strands, and dividing above into delicate capillitium-like threads; spores and threads rusty-brown.

KEY TO THE SPECIES OF *RETICULARIA*.

Spores minutely reticulated.	1. *R. Lycoperdon*
Spores coarsely reticulated.	2. *R. lobata*

1. **R. Lycoperdon** Bull., *l.c.*, t. 446, f. 4 (1791). Plasmodium creamy-white, on dead wood. Æthalium pulvinate or subglobose, 2 to 6 cm. diam., enclosed in a thin smooth silvery cortex, seated on a well-developed hypothallus of interwoven membranous strands. Capillitium consisting of the persistent remains of the sporangium-walls, forming irregular chambered and branching strands arising from the hypothallus, dividing above into numerous delicate flattened and flexuose threads; together with the spores pale rusty-brown. Spores somewhat turbinate, thickened and closely reticulated on the rounded side, the remaining part marked with scattered warts, 6 to 8 μ diam.—Rost., Mon., p. 240; Cooke, Myx. Brit., p. 60; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 10; Mass., Mon., p. 93. *Reticularia umbrina* Fr., Syst. Myc., iii., p. 87. *R. argentea* Corda, Ic. Fung, vi., p. 15.

Plate LIX., B.—*a*. æthalium, half natural size; *b*. capillitium, × 80; *c*. spores, × 600 (England).

In æthalia developed in a moist atmosphere under a glass shade the silvery cortex formed by the drying of the outer ends of the sporangia is not produced, but the convolute sporangia are filled with spores to their apices, which gives an irregular brain-like surface to the æthalium. In some gatherings the walls of the sporangia are much more persistent than in others, and have almost the character of *Enteridium*, to which genus *Reticularia* is closely allied.

Hab. On dead wood.—Bristol (B. M. 18); Leytonstone, Essex (L:B.M.131); Germany (Strassb. Herb. and B. M. 649); Sweden (K. 977).

2. **R. lobata** Lister. Plasmodium watery-white, in decayed wood. Æthalia small, consisting of irregularly clustered and confluent sporangia, or spreading over the substratum in flattened lobes about 0·5 mm. diam., shining, iridescent, rusty-brown; walls of the æthalium membranous, soon evanescent; sporangium-walls within the æthalium rising from the hypothallus in membranous folds and merging into a scanty network of more or less delicate flattened threads; together with the spores rusty-brown. Spores sharply reticulated on two-thirds of the surface, faintly and irregularly reticulated on the remaining third, 6 to 10 μ diam. *Reticularia Rozeana* List., in Journ. Bot. (1891), p. 263 (non Rost.).

Plate LIX., B.—*d.* æthalium, × 10; *e.* capillitium, × 80; *f.* spores, × 600 (England).

This species has been gathered in four consecutive years on a Spanish chestnut stump in Wanstead Park, Essex; it has been found near Woking and at Leighton Buzzard, and has also been collected by Mr. Camm near Birmingham. Examples of the form were submitted to Dr. Rex, who compared them with American gatherings of *Enteridium Rozeanum* Wing., and pronounced it to be a new species distinguished by the *Reticularia* character of the æthalia and by the more uniformly reticulated spores. Specimens of *E. Rozeanum*, from Philadelphia, Ohio, and Iowa, confirm the opinion of Dr. Rex, and correct my notice in the *Journal of Botany* (*l.c.*) giving the English gatherings as "*Reticularia Rozeana* Rost.," but the two species are closely allied.

Hab. On dead wood.—Wanstead, Essex (L:B.M.132); Leighton, Beds (L:B.M.132); Woking, Berks (L:B.M.132); Birmingham (L:B.M.132).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

3. **R. fuliginosa** Berk. & Br., in Journ. Linn. Soc., xiv., p. 82 (1873). Effused, thin, dark olive-brown, silky; flocci purple-black; spores globose, purple-black, smooth.

Hab. On palm leaves.—Ceylon.

SPECIES EXCLUDED FROM THE MYCETOZOA.

R. affinis Berk. & Curt., *R. apiospora* Berk. & Br., *R. atro-rufa* Berk. & Curt., *R. polyporiformis* Berk., *R. pyrrhospora* Berk., and *R. venulosa* Berk. & Curt.

Subcohort III.—*CALONEMINEÆ*. Sporangia simple, except in *Lycogala*; capillitium always present, forming a system of uniform threads; spores yellow, red, or grey.

Order I.—TRICHIACEÆ. Capillitium consisting of free elaters, or combined into an elastic network, with thickenings in the form of spirals or complete rings.

KEY TO THE GENERA OF *TRICHIACEÆ*.

Capillitium abundant, consisting of free elaters with spiral thickenings. (33) TRICHIA.

Fig. 41.—*Trichia affinis* de Bary.

a. Group of sporangia. Twice natural size.
b. Elater. Magnified 250 times.
c. Spore. Magnified 400 times.

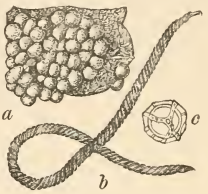

Fig. 41.

Capillitium scanty, consisting of free elaters with imperfect spiral thickenings; sporangia minute, heaped. (34) OLIGONEMA.

Fig. 42.—*Oligonema nitens* Rost.

a. Cluster of sporangia. Magnified 3 times.
b. Elater. Magnified 280 times.
c. Spore. Magnified 400 times.

Fig. 42.

Capillitium combined into a network, with spiral thickenings. (35) HEMITRICHIA.

Fig. 43.—*Hemitrichia rubiformis* Lister.

a. Cluster of sporangia. Magnified 2½ times.
b. Capillitium. Magnified 280 times.
c. Spore. Magnified 400 times.

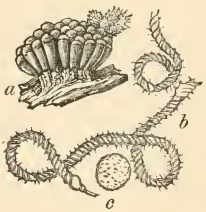

Fig. 43.

Capillitium combined into a network, with thickenings in the form of rings. (36) CORNUVIA.

Fig. 44.—*Cornuvia Serpula* Rost.

a. Plasmodiocarp. Magnified 7 times.
b. Capillitium. Magnified 250 times.
c. Spore. Magnified 400 times.

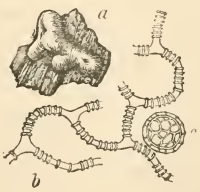

Fig. 44.

Genus 33.—**TRICHIA** Haller, Hist. Stirp. Helv., iii., p. 114 (1768). Sporangia stalked or sessile; sporangium-wall membranous, sometimes charged with granular matter; capillitium yellow or brown, consisting of free elastic threads, pointed at each end, and thickened with two to five spiral bands; spores reticulated, or minutely warted.

KEY TO THE SPECIES OF *TRICHIA*.

A. Spores reticulated, or marked with broken bands:—

Elaters 7 to 8 μ wide, spores reticulated, border 2 μ wide. 1. *T. favoginea*

Elaters 4 to 5 μ wide, spores reticulated with narrow bands, border 1 μ wide, sporangia stalked. 2. *T. verrucosa*

Elaters 4 to 6 μ wide, spores reticulated with broad pitted bands, border 0·5 to 1 μ wide, sporangia sessile. 3. *T. affinis*

Elaters 4 to 6 μ wide, spores with broken reticulation of broad pitted bands, border 0·5 μ wide, sporangia sessile. 4. *T. persimilis*

Elaters 4 to 6 μ wide, spores very closely reticulated, border none, sporangia sessile. 5. *T. scabra*

B. Spores minutely warted:—

A. Spirals of elaters two. 6. *T. varia*

B. Spirals of elaters three or more—

a. Elaters shortly tapering at the ends—

Sporangia sessile, wall uniformly thickened with granular matter; elaters smooth or spinulose. 7. *T. contorta*

Sporangia stalked, wall membranous, with rounded areas thickened with granular deposits; elaters spinose. 8. *T. erecta*

b. Elaters smooth, very gradually tapering at the ends—

Stalk hollow, filled with spore-like cells. 9. *T. fallax*

Stalk solid. 10. *T. Botrytis*

1. **T. favoginea** Pers., in Röm., N. Mag. Bot., i., p. 90 (1794). Plasmodium? Sporangia globose, ovoid, or clavate, crowded, sessile or shortly stalked, on a membranous hypothallus; 0·6 to 0·7 mm. broad, 0·7 to 1·9 mm. high, ochraceous-yellow; mass of spores and capillitium orange-yellow; sporangium-wall membranous, minutely thickened with irregular striæ. Stalk membranous, rarely present. Capillitium of long cylindrical elaters 7 to 8 μ diam., smooth or with scattered spines, thickened

with four to five spiral bands 1 μ broad, the intervals 1 to 2 μ, crossed by slender ridges running parallel with the length of the elater and connecting the bands; the ends of elaters conical, terminating in a smooth point 3 to 8 μ long. Spores yellow, the wall reticulated with narrow, deep bands forming a net with three to five meshes to the hemisphere; 13 to 15 μ diam., including the border of 1·6 to 2 μ width, which represents the depth of the band.—Schum., En. Pl. Saell., ii., p. 207 (1803). *Lycoperdon favogineum* Batsch, Elench. Fung. Cont., p. 257 (1786). *Stemonitis favoginea* Gmel., Syst. Nat., ii., p. 1470 (1791). *Trichia nitens* Pers., Obs. Myc., i., p. 62 (1796). *Sphærocarpus chrysospermus* Bull., Champ., t. 417, f. 4 (1791). *Trichia chrysosperma* DC., Syn. Pl. Gall., p. 52 (1806); Rost., Mon., p. 255; Cooke, Myx. Brit., p. 64, figs. 213, 240; Blytt, Bidr. K. Norg., Sop. iii., p. 12; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 130; Mass., Mon., p. 189.

Plate LX., A.—*a*. sporangia, × 20; *b*. elater, × 600; *c*. spore, × 600 (Freiburg, Germany).

The species of *Trichia* with reticulated spores are separated from each other by somewhat arbitrary lines, owing to the inconstancy of the distinctive characters. The descriptions under the several names are here given from the type specimens in the Strassb. Herb.; they represent well marked centres, but in this abundant and widespread genus forms are of frequent occurrence which take an intermediate position. The character of longitudinal striæ connecting the bands on the elaters is met with to a greater or less extent in each member of the group. In extensive gatherings on old pine stumps in the Black Forest, the elaters are nearly regular in breadth, usually 8 μ diam., but some measure 7 μ and some 6·5 μ; the connecting striæ are almost always but not invariably distinct; the spores have mostly unbroken bands without pits, and show a border 2 μ diam.; in some parts of several gatherings the bands are broader, broken and pitted, and the border reduced to a slight thickening of the spore-wall: but in all these specimens a considerable part retains the character of *T. favoginea* in the narrow and even bands on the spores and broad elaters. American gatherings show similar variation; sometimes with spores having regular reticulation and narrow bands, the elaters are only 6 μ diam. Between *T. affinis* and *T. persimilis*, and between *T. persimilis* and *T. scabra*, intermediate forms frequently occur where it is often difficult to decide under which head to place them. The length and markings of the elaters is also a varying character. A gathering of *Hemitrichia chrysospora* List. has been found at Lyme Regis of the Trichia form with free elaters; *T. scabra* has occurred with the capillitium consisting of a dense network of the extreme Hemitrichia type, with no free elaters; *T. affinis* and *T. scabra*, when exposed to severe changes of temperature, at the time of their fruiting, have developed elaters with the spirals to a great degree modified into complete rings, approaching the markings on the elaters of *Cornuvia Serpula*; and *T. persimilis* under similar conditions has produced very short elaters with broad rings and faint spirals with much the same character as *Oligonema nitens*. With such blending of form, which indicates a relationship between all these species, the characters given in the key must be taken as approximate, and mark the main centres around which the numerous varieties group themselves.

Hab. On dead wood.—Bulstrode, Buckinghamshire (B. M. 1114); Sutton, Warwick (L:B.M.133); Baden Baden (L:B.M.133); Salem, Germany (B. M. 777, 783); Switzerland (B. M. 1140); Sweden (K. 1179); Poland (Strassb. Herb.); Philadelphia (L:B.M.133).

2. **T. verrucosa** Berk., in Hook., Fl. Tasm., ii., p. 269 (1860). Plasmodium? Total height 2 to 4 mm. Sporangia pyriform or clavate, stipitate, clustered or solitary, 1·4 mm. high, 0·8 mm. broad, ochraceous-yellow, mass of elaters and spores golden-yellow; sporangium-wall membranous, minutely and closely papillose, pale yellow. Stalks membranous, 1 to 2 mm. high, usually combined in clusters of three or four, rugose, yellow-brown, or dark brown. Capillitium of long cylindrical elaters, 4 to 6 μ wide, with short conical ends, marked with three to five narrow spiral bands, smooth, or with a few scattered spines, longitudinal striæ distinct. Spores reticulated with narrow, minutely pitted bands, forming a network with about seven meshes to the hemisphere, 13 to 16 μ diam., border 1 μ wide.—Mass., Mon., p. 191. *T. superba* Mass., in Journ. R. Micr. Soc. (1889), p. 345; Mass., Mon., p. 194.

Plate LX., B.—*a.* sporangia, × 20; *b.* elater, × 600; *c.* spore, × 600 (New Zealand).

The specimen from Tasmania (K. 1750) described by Berkeley as *T. verrucosa* is somewhat immature, but is sufficiently developed to be clearly identified as the same species as *T. superba* Mass. from New Zealand. A fine specimen of the same form from Chili, in the Strassburg Herb., is named by Rostafinski *T. chrysosperma*. It is no doubt closely allied to that species, but the constancy of the characters of the stalked sporangia and of the spores marked with a rather close reticulation of narrow bands forming a border scarcely 1 μ broad supports the specific distinction. A large gathering by Prof. Balfour in Scotland shows the same characters.

Hab. On dead wood.—Moffat, Scotland (L:B.M.134); Tasmania (K. 1750, 1751); New Zealand (K. 1166, 1167, 1764); Chili (Strassb. Herb.).

3. **T. affinis** de Bary, in Fuckel, Symb. Myc., p. 336 (1869). Plasmodium watery-white, in dead wood. Sporangia globose, sessile, crowded on a membranous hypothallus, 0·6 to 1 mm. diam., shining golden or ochraceous-yellow; mass of elaters and spores bright yellow; sporangium-wall membranous, pale yellow, marked with delicate irregular striæ. Capillitium of long cylindrical elaters, 4 to 6 μ diam., with conical pointed ends, marked with four to five spiral bands, smooth, or with minute scattered spines; longitudinal striæ usually present, but often faint. Spores reticulated with broad, rarely narrow, pitted bands, forming a more or less complete net with three to five meshes to the hemisphere, 13 to 15 μ diam., border 0·5 to 1 μ wide.—Rost., Mon., p. 257; Cooke, Myx. Brit., fig. 241; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 13; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 131; Mass., Mon., p. 194. *Trichia Kalbreyeri* Mass., in Journ. R. Micr. Soc.

(1889), p. 344; Mass., Mon., p. 191. *Trichia intermedia* Mass., in Journ. R. Micr. Soc. (1889), p. 341; Mass., Mon., p. 188. *Trichia pulchella* Rex, in Proc. Ac. Nat. Sc. Phil. (1893), p. 366.

Plate LX., B.—*d.* elater, × 600; *e.* spore, × 600 (England).

T. pulchella Rex differs from the usual developments of *T. affinis* in the more scattered habit of growth of the sporangia; the elaters are narrow, being 3·5 to 4·5 μ diam.; the spores have a border 1 μ wide and are reticulated with narrow, minutely pitted raised bands, presenting from three to four meshes on the hemisphere; it can hardly be considered as having distinctive specific characters. The type specimen of *T. Kalbreyeri* Mass., from New Granada (K. 1196), has elaters 5 μ diam., with delicate longitudinal striæ, and spores marked with a rather close reticulation of broad, faintly pitted bands; it does not appear to differ from typical *T. affinis*. The type specimen of *T. intermedia* Mass. from Scarborough has elaters 4 to 6 μ diam., and is almost identical with de Bary's type of *T. affinis* in the Strassburg Herbarium both in capillitium and spores.

Hab. On dead wood.—Addington, Surrey (B. M. 362); Leicestershire (B. M. 363); Heydon (B. M. 1115) and Wanstead, Essex (L:B.M.135); Lyme Regis, Dorset (L:B.M.135); Cotterel, Cheshire (B. M. 1125); Edinburgh (K. 1180); Germany (B. M. 785 and Strassb. Herb.); Australia (L:B.M.135); Philadelphia (L:B.M.135); Iowa (B. M. 834); S. Carolina (B. M. 959); Cuba (K. 1118); New Granada (L:B.M.135 *slide*); Chili (Paris Herb.).

4. **T. persimilis** Karst., in Not. Saellsk. pro Fauna et Flora Fenn. Forh. (1868), p. 353. Plasmodium watery-white, in rotten wood. Sporangia globose, crowded, seated on a common membranous hypothallus, 0·5 to 0·8 mm. diam., brown or yellow-brown, shining; capillitium and spores in mass yellow or yellow-brown. Capillitium of cylindrical elaters, 4 to 6 μ diam., marked with about four closely set spiral bands, usually beset with numerous short slender spines; the ends of the elaters conical, acute, or with the spiral bands produced at the apex into two or three diverging points; longitudinal striæ inconspicuous. Spores yellow, or yellow-brown, 11 to 14 μ diam., with the reticulation broken, or represented by irregular pitted warts, border interrupted.—*Trichia Jackii* Rost., Mon., p. 258 (1875); Cooke, Myx. Brit., fig. 242; Mass., Mon., p. 188. *Trichia proximella* Karst., in Bidr. Känn. Finl. Nat., xxxi., p. 139; Mass., Mon., p. 180. *Trichia abrupta* Cooke, in Ann. Lyc. Nat. Hist. N. York, xi., p. 404; Cooke, Myx. Brit., fig. 256; Mass., Mon., p. 187. *Trichia Balfourii* Mass., in Journ. R. Micr. Soc. (1889), p. 339; Mass., Mon., p. 186. *Trichia sulphurea* Mass., in Journ. R. Micr. Soc. (1889), p. 339; Mass., Mon., p. 186.

Plate LX., A.—*g.* elater, × 600; *h.* spore, × 600 (England).

A type specimen from Finland, from Dr. Karsten, agrees essentially with the examples of *T. Jackii* Rost. in Strassb. Herb.; the latter name must therefore be dropped as being antedated. The occurrence of the long spinous processes on the elaters, noted in the original description of *T. persimilis*, is not a constant character.

A form with the ends of the elaters obtuse, and the spiral bands continued at the apex into widely diverging spines, has been named *T. abrupta* Cooke, but this character is also found occasionally in *T. favoginea*, *T. affinis*, and *T. scabra*. *T. proximella* Karsten and *T. sulphurea* Mass. have elaters 4·5 to 5 μ diam., and spores with the bands much broken; *T. Balfourii* Mass. has the elaters 4 to 5 μ diam., and the reticulation on the spores consists of wide, broken and pitted bands. They present no character by which they can be separated from *T. persimilis*.

Hab. On dead wood, leaves, etc.—Batheaston, Somerset (B. M. 367); Penzance (B. M. 370); Epping Forest, Essex (L:B.M.136); Lyme Regis, Dorset (L:B.M.136); Boynton, Yorkshire (B. M. 1125); Glamis, Scotland (B. M. 369); Germany (Strassb. Herb.); France (K. 1183); Finland (L:B.M.136 *slide*); Cape (K. 1047); Ceylon (K. 1749); Java (K. 1755); Philadelphia (L:B.M.136).

5. **T. scabra** Rost., Mon., p. 258 (1875). Plasmodium watery-white, in rotten wood. Sporangia globose, crowded, seated on a common membranous hypothallus, 0·6 to 0·9 mm. diam., shining, yellow-brown. Capillitium and spores in mass bright orange-yellow. Capillitium of long, cylindrical bright yellow elaters, 4 to 6 μ diam., with four or five bands arranged in somewhat irregular spirals, either close or distant, beset with spines, or nearly smooth, the ends acutely conical or with the bands produced at the apex in more or less diverging points, longitudinal striæ rarely evident. Spores yellow, minutely reticulated with depressed bands forming a complete or fragmentary net with about forty meshes to the hemisphere, or irregularly warted, the spore border being reduced to a spinulose margin, 9 to 11 μ diam. —Cooke, Myx. Brit., figs. 214, 239; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 13; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 132; Mass., Mon., p. 192. *Trichia minima* Mass., in Journ. R. Micr. Soc. (1889), p. 336; Mass., Mon., p. 182. *Trichia nitens* Fries, Mass., in Journ. R. Micr. Soc. (1889), p. 333; Mass., Mon., p. 179. *Arcyria Bucknalli* Mass., Mon., p. 161.

Plate LX., A.—*d.* sporangia, × 20; *e.* & *é.* elaters, × 600; *f.* spore, × 600 (England).

The type of *Arcyria Bucknalli* Mass., from Bristol (K. 1774), is an interesting form of *T. scabra*; the capillitium is spinose, and consists of long, sparingly branched free elaters, not combined into a network; the spiral bands are in many parts entirely modified into rings, a character which is often seen in a less degree in imperfect developments of this species; the spores are of the typical form of *T. scabra*. The specimen from Luton (L:B.M.137) has the dense net of a *Hemitrichia* and no free elaters; the close and rugged spirals on the threads have in some parts an annular arrangement; it is, however, an undoubted form of *T. scabra* with typical spores. The type of *T. minima* Mass., from Oldham (K. 1044), has spinulose elaters 4 to 5 μ diam.; the spores measure 9 μ, some are delicately reticulated, in others the net is broken into warts and short bands; it is not an unusual form of *T. scabra*. A type specimen of *T. nitens* (K. 1104) has spores 9 to 10 μ diam., for the most part delicately reticulated, but some have the bands much broken; the elaters measure 4 to 5 μ diam., with regular spiral

bands and only a few short scattered spines ; it appears to be a typical form of *T. scabra*, except that the elaters are rather more smooth than usual.

Hab. On dead wood.—Wothorpe, Northamptonshire (B. M. 366) ; St. Catherines, Somerset (B. M. 368) ; Wanstead, Essex (L:B.M.137) ; Lyme Regis, Dorset (L:B.M.137) ; Luton, Beds (L:B.M.137) ; Germany (B. M. 779) ; Sweden (K. 1104) ; Poland (Strassb. Herb.) ; Philadelphia (L:B.M.137) ; Iowa (B. M. 835) ; Ohio (L:B.M.137).

6. **T. varia** Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). Plasmodium white, in rotten wood. Sporangia globose, ovoid or turbinate, sessile or stalked, 0·6 to 0·9 mm. diam., or forming short plasmodiocarps, crowded or scattered, ochraceous or olivaceous ; sporangium-wall membranous, pale yellow, marked with ring-shaped or crescentic thickenings 8 μ diam. Stalks 0·1 to 0·5 mm. high, 0·2 to 0·3 mm. thick, black, furrowed. Capillitium of cylindrical, ochraceous-yellow elaters, 3 to 5 μ diam., marked with two prominent bands forming a loose spiral, tapering shortly at the ends and terminating in a curved point. Spores ochraceous-yellow, minutely warted, 11 to 16 μ diam.—Rost., Mon., p. 251 ; Cooke, Myx. Brit., p. 63, figs. 191, 202, 208, 212, 218, 237 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 129 ; Mass., Mon., p. 178. *Stemonitis varia* Pers., in Gmel., Syst. Nat., p. 1470 (1791). *Trichia nigripes* Pers., Syn., p. 178 (1801).

Plate LXI., A.—*a.* sporangia, × 20 ; *b.* elater, × 600 ; *c.* spore, × 600 (England).

Sporangia with longer or shorter stalks frequently occur with sessile forms arising from the same plasmodium.

Hab. On dead wood.—Batheaston, Somerset (B. M. 361) ; Leicestershire (B. M. 379) ; Lyme Regis, Dorset (L:B.M.138) ; Hampstead (B. M. 1122) and Highgate, London (B. M. 1120) ; Brandon, Suffolk (B. M. 1121) ; Bud's Clough, Cheshire (B. M. 1117) ; France (Paris Herb.) ; Germany (B. M. 768) ; Switzerland (B. M. 1141) ; Finland (K. 1124) ; Italy (K. 1148) ; Philadelphia (L:B.M.138) ; Iowa (L:B.M. 138) ; S. Carolina (B. M. 800).

7. **T. contorta** Rost., Mon., p. 25 (1875). Plasmodium watery-white, in bark and rotten wood. Sporangia subglobose, sessile, crowded or scattered, 0·5 to 0·8 mm. diam., or forming elongated curved plasmodiocarps, dull yellow-brown or dark red-brown ; mass of spores and elaters yellow or ochraceous ; sporangium-wall charged with brown granular matter. Capillitium of irregularly cylindrical threads, with indistinct or rugged spiral thickenings, or of equal elaters with four or five distinct closely set spiral bands, 3 to 5 μ diam., the tips usually swollen and ending in a curved point, yellow or yellow-brown. Spores yellow, minutely spinulose, 10 to 14 μ diam.—Cooke, Myx. Brit., fig. 229 ; Mass., Mon., p. 182. *Lycogala contortum* Ditm., in Sturm, Deutsch. Fl., iii., p. 8, tab. 5 (1813). *Hemitrichia contorta* Rost., in Fuckel, Sym. Myc., Nachtr., p. 75. *Trichia inconspicua* Rost., Mon., p. 259 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 13 ; Macbride, in Bull. Nat.

Hist. Iowa, ii., p. 132; Mass., Mon., p. 180. *Trichia reniformis* Peck, in Rep. N. York Mus., xxvi., p. 76; Mass., Mon., p. 184. *Trichia Andersonii* Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 395. *Trichia advenula* Mass., in Journ. R. Micr. Soc. (1889), p. 336; Mass., Mon., p. 181. *T. heterotrichia* Balf., in Grev., x., p. 117; Mass., Mon., p. 174. *T. Iowensis* Macbride, *l.c.*, p. 133.

α. **genuina**: elaters more or less uneven from constrictions and irregular swellings, with indistinct or rugged spiral thickenings.

β. **inconspicua**: elaters evenly cylindrical, usually swollen behind the gradually tapering pointed ends; spiral bands distinct, regular, delicate.

γ. **lutescens**: sporangia yellow, subglobose; sporangium-wall membranous; elaters smooth with faint spirals.

Plate LXI., B.—*a. α. genuina*, sporangia, × 20; *b.* sporangium-wall and spores, × 280; *c.* elaters, × 600; *d.* spore, × 600 (England); *e. β. inconspicua*, sporangia, × 20; *f.* elater, × 600 (Switzerland: one of Rostafinski's types).

Although the two varieties are well contrasted, intermediate forms are of frequent occurrence, and the variations of capillitium described above have on several occasions been found represented in different sporangia of the same group. *T. inconspicua* cannot therefore be regarded as a distinct species. *T. reniformis* Peck, of which a typical specimen has been received from Dr. Rex, has the granular thickening of the sporangium-wall and the rugged irregular spirals of *T. contorta* var. *genuina*. A type specimen of *T. Andersonii* Rex is very similar to the last in the form of the capillitium, but the brown granules in the sporangium-wall are less abundant. Associated with all varieties of capillitium, the wall in English gatherings may either be densely charged with brown granules resembling the structure in *Perichæna corticalis*, or it may be similar to that in *T. Andersonii*; the difference in colour between spores and capillitium mentioned by Dr. Rex in his description of this species (*l.c.*) is also a varying character, and it is difficult to separate the form from *T. contorta*. The type of *T. advenula* Mass., from Glamis (K. 1748), has the sporangium-wall charged with brown granular matter; the spirals on the elaters are regular and distinct; it is similar to Rostafinski's type of *T. inconspicua* in Strassb. Herb. *T. heterotrichia* Balf., from Currey's collection (K. 1066), appears to be an immature specimen of *T. contorta* var. *genuina*; the sporangium-walls are almost free from granular deposits; the elaters are 4 to 5 μ diam., marked with one or three rugged or indistinct spiral bands, and scattered blunt spines; the spores adhere to one another, and are very faintly minutely spinulose; they measure 12 to 13 μ. *T. Iowensis* Macbride (*l.c.*) agrees with *T. contorta* in the habit and colour of the sporangia, in the granular sporangium-wall, and in the spores; the elaters are 3 μ diam., and, in addition to being marked with about four inconspicuous spiral bands, are beset with numerous slender flexuose spines 5 to 10 μ long. It appears only to have been found near Iowa City, and exclusively on the bark of poplar in the month of October. Scattered spines are occasionally met with on the elaters of *T. contorta*, and *T. Iowensis* appears to be an extreme local form of this species; a type specimen is in the British Museum Herb. Var. *γ* has been found in Norway, September 1894, in considerable abundance, and at stations separated by many miles. The only characters in which it

differs from var. *a.* is the membranous sporangium-wall, which is entirely free from granular deposits, and under a low magnifying power is seen to be embossed by the impression of the spores. This character, however, indicates so considerable a divergence from the type, that if further gatherings established its constancy this form should be marked as a distinct species.

Hab. On bark and dead wood.—*β.* Batheaston, Somerset (B. M. 351); *a.* Lyme Regis, Dorset (L:B.M.139); *a.* Wanstead, Essex (L:B.M.139); *β.* Menmuir, Brechin, Scotland (B. M. 365); *a.* France (K. 997); *a.* Germany (K. 1771); *a.* Poland (Strassb. Herb.); *β.* Switzerland (Strassb. Herb.); *β.* Sweden (K. 1702); *β.* Norway (Christiania Herb.); *β.* Mass., U.S.A. (L:B.M.139); *β.* Iowa (L:B.M.139); *a.* Montana (L:B.M.139); *γ.* on fir and birch, Norway (L:B.M.139).

8. **T. erecta** Rex, in Proc. Acad. Nat. Sc. Phil. (1890), p. 193. Plasmodium? Total height 1 to 2 mm. Sporangia globose or subturbinate, stipitate or nearly sessile, scattered, 0·5 to 0·7 mm. diam., bright yellow, mottled with well-defined, dark brown angular patches; sporangium-wall membranous, pale yellow, densely charged with brown angular matter in the dark patches. Stalk cylindrical, 0·5 to 1 mm. high, 0·2 to 0·3 mm. thick, dark brown, opaque. Capillitium of cylindrical bright yellow elaters, 3·5 to 4 μ diam., with short tapering ends; marked with four bands forming a close irregular spiral, beset with numerous spines. Spores yellow, delicately warted, 11 to 13 μ diam.—Mass., Mon., p. 184.

Plate LXII., A.—*e.* sporangia, × 20; *f.* elater, × 600; *g.* spore, × 600 (United States).

A single specimen of this species has been found at Lyme Regis, agreeing in every respect with the type received from Dr. Rex, except that the stalk is very short, 0·5 mm. high.

Hab. On dead wood, etc.—Lyme Regis, Dorset (L:B.M.140 *slide*); Philadelphia (L:B.M.140).

9. **T. fallax** Pers., Obs. Myc., i., p. 59 (1796). Plasmodium rose-coloured or white, in rotten wood. Total height 1·5 to 3 mm. Sporangia turbinate, stipitate, gregarious, 0·6 to 0·8 mm. diam., shining olive or yellow-brown; sporangium-wall yellow, membranous, of two layers. Stalk cylindrical, furrowed, 0·5 to 1 mm. long, olive or dark brown; hollow, filled to the base with spores or spore-like cells. Capillitium of cylindrical, smooth, olive-brown elaters, 4·5 to 5·5 μ diam., marked with four or five spiral bands, 0·5 to 1 μ broad, with intervals of 0·5 to 3 μ, gradually tapering into long slender points. Spores yellow-brown, minutely warted, or more or less distinctly reticulated on one side, 9 to 12 μ diam.—Rost., Mon., p. 243; Cooke, Myx. Brit., p. 61, figs. 221, 222, 233, 235; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 128; Mass., Mon., p. 192. *Arcyria decipiens* Pers., in Usteri, Ann. Bot., xv., p. 35 (1795).

Plate LXII., A.—*a.* sporangia, × 20; *b.* elater, × 600; *c.* spores, × 600 (England); *d.* spore, reticulated on one side, spinulose on the other (United States).

The elaters vary in length in different gatherings ; usually they are long and taper only towards the ends ; sometimes they are short and somewhat fusiform, and either simple or branched. The warts on the spores may be scattered, numbering eight to ten in a line across the hemisphere, or more crowded ; in some American specimens the spores are closely reticulated on one side, and spinulose on the other. The white and rose-coloured plasmodia have not been observed growing together on the same piece of wood, but the sporangia produced from both appear to be identical in every respect ; although shades of difference occur in various gatherings, the colour of the plasmodium cannot be inferred from the ripe fruits.

Hab. On dead wood. Common.—St. Catherines, Somerset (B. M. 387, 359, etc.) ; Lyme Regis, Dorset (L:B.M.141) ; Boynton, Yorkshire (B. M. 1124) ; France (K. 1059) ; Germany (B. M. 749, 750) ; Iowa (B. M. 836) ; S. Carolina (K. 1053).

10. **T. Botrytis** Pers., in Römer, N. Mag. Bot., i., p. 89 (1794). Plasmodium purple-brown, in dead wood. Total height 1·5 to 5 mm. Sporangia pyriform or turbinate, stipitate, simple or combined in clusters, 0·6 to 0·8 mm. diam., red-brown, purple, or black, often marked with paler lines of dehiscence ; mass of elaters and spores yellow-brown, orange, or reddish-brown ; sporangium-wall of two layers, the outer charged with granular matter and continued into the stalk, the inner membranous, enclosing the spores. Stalks cylindrical, often combined in clusters of three to eight, furrowed, red or purple-brown, solid, not containing spore-like cells. Capillitium of cylindrical or fusiform, pale-brown or reddish-brown elaters, 4 to 5 μ diam., sometimes branched, gradually tapering to long slender points, marked with three to five flattened or prominent spiral bands, with intervals of about 1 μ. Spores ochraceous or reddish-yellow, minutely spinulose, 9 to 11 μ diam.—*Trichia fragilis* Rost., Mon., p. 246 ; Cooke, Myx. Brit., p. 62, figs. 203, 204, 225, 226 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12 ; Mass., Mon., p. 175. *Sphærocarpus fragilis* Sow., Eng. Fung., t. 279 (1803). *Trichia pyriformis* Fr., Syst. Myc., iii., p. 184. *Trichia Decaisneana* de Bary, Rost., Mon., p. 250 ; Mass., Mon., p. 185. *Trichia lateritia* Lév., in Ann. Sc. Nat., Ser. 3, v., p. 167 ; Rost., Mon., p. 250. *Trichia purpurascens* Nyl., in Saellsk. Faun. Fl. Fenn., Ny. Ser. (1858, 1859), p. 126 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12 ; Mass., Mon., p. 177. *Trichia Carlyleana* Mass., in Journ. R. Micr. Soc. (1889), p. 329 ; Mass., Mon., p. 174. *Trichia subfusca* Rex, in Proc. Acad. N. Sc. Phil. (1890), p. 192.

α. **genuina**: stalks purple or purple-brown, 1 to 1·5 mm. long; elaters brown or ochraceous-brown, terminating in a slender tapering point, from 50 to 70 μ long, the spirals disappearing in the last third ; spores yellow.

Hab. On wood.

β. **lateritia**: stalks red, 2 mm. or more long ; elaters pale burnt-sienna colour, terminating in a more or less abruptly taper-

ing point, 20 to 40 μ long, the spirals continued almost to the extremity; spores orange-yellow.—*T. lateritia* Lév., *l.c.*

Hab. On wood.

γ. **flavicoma**: sporangia minute; stalks brown, 0·25 mm. long; elaters bright yellow, of the form α; spores yellow.

Hab. On dead leaves.

δ. **subfusca**: stalks purple-brown, 0·5 mm. long; elaters bright yellow, of the form β; spores bright yellow.—*T. subfusca* Rex, *l.c.*

Hab. On wood.

Plate LXII., B.—*a*. var. *α. genuina*, sporangia, × 20; *b, c*. elaters, × 600; *d*. spore, × 600 (England); *e*. var. *β. lateritia*, sporangia, × 20; *f, g, h*. elaters, × 600; *i*. spore, × 600 (Germany); *j*. var. *γ. flavicoma*, sporangia, × 20; *k*. elater, × 600 (England); *l*. var. *δ. subfusca*, sporangium, × 20; *m*. elater, × 600; *n*. spore, × 600 (United States).

The various characters distinguishing the different forms of this abundant species blend freely into one another, but the colour of the capillitium and spores is generally associated with a form of the elaters of sufficient constancy to enable the specimens to be classed under the above varieties. The three varieties given by Rostafinski are distinguished by the colour of the sporangia, and of the capillitium and spores when seen in mass; but the colour of the sporangium is a character which varies so widely that it cannot be taken as marking constant types; specimens in the Strassburg Herbarium have sessile, black, and brittle sporangia associated with others of brown and bright nut colour; a few have long stalks, and others are clustered on a common stem. In a large cultivation from a single growth of plasmodium at Lyme Regis, the sporangia are either olive or rosy-purple, marbled over with yellow lines of dehiscence, or almost uniformly black. *T. lateritia* Lév., from Chili (K. 1761), here taken as the type of var. β, has nearly black sporangia, but other gatherings from England and the Continent, with similar characters of capillitium and spores, have either black, rosy, or brown sporangia. The "simple" or "*botrytis*" forms are mingled in most large gatherings, but the "*botrytis*" form is most frequent in var. β. The type specimen of *T. Decaisneana* de Bary, in the Strassburg Herbarium, is included under var. β; the elaters are remarkably long, suddenly narrowing to a point 10 to 15 μ in length, from a subterminal bulb; a similar bulb occurs in the middle of some of the elaters; the occurrence of bulbous swellings in the elaters is so frequent and at the same time so inconstant in many species of *Trichia* that it can scarcely be received as a specific character. *T. Carlyleana* Mass. is the form *a* with minutely spinulose spores, perhaps more nearly smooth than may be considered typical. *T. purpurascens* Nyl., of which a type specimen has been furnished by Prof. Blytt, is also form *a*, and has dull purple sporangia; the spores average 10 μ diam., and are minutely spinulose. The form γ *flavicoma* has been obtained from Moffat, and on four separate occasions on leaves at Lyme Regis; the sporangia are brown, or purple with yellow lines of dehiscence, and the elaters bright yellow. *T. subfusca* Rex, here placed as var. δ of *T. Botrytis*, has dull brown sporangia, and differs from var. γ only in the ends of the elaters being shorter and with more prominent spirals, a character of not sufficient importance to give the form specific rank.

Hab. On dead wood and leaves. Common.—Orton, Leicester (B. M. 391); Lyme Regis, Dorset (L:B.M.142); Leigh, Somerset (B. M. 399); Glamis, Scotland (B. M. 385); Germany (B. M. 759); Poland (Strassb. Herb.); Finland (K. 1090); Switzerland (B. M. 760); Italy (B. M. 758); Ceylon (B. M. 762); Australia (K. 1082); Tasmania (K. 1759); New Zealand (K. 1098); Philadelphia (L:B.M.142); Mass., U.S.A. (L:B.M.142); Chili (K. 1761).

SPECIES EXCLUDED FROM THE GENUS.

T. Kickxii Rost. = *Oligonema nitens* Rost.
T. pusilla Schroet. = *Oligonema nitens* Rost.
T. nana Mass. = *Hemitrichia Wigandii* Lister.

Genus 34.—**OLIGONEMA** Rostafinski, Mon., p. 291 (1875). Sporangia minute, densely clustered; capillitium scanty, of short or long threads, with spiral markings indistinct or wanting; spores reticulated.

1. **O. nitens** Rost., *l.c.*, f. 198 (1875). Plasmodium? Sporangia subglobose, sessile, heaped together in clusters, 0·3 to 0·4 mm. diam., shining, yellow or olivaceous-yellow; sporangium-wall membranous, yellow. Capillitium of short or long, cylindrical, yellow elaters, 3 to 5 μ diam., with rounded or abruptly pointed ends, marked with one to four irregular indistinct spiral bands, which are sometimes wanting, occasionally with ring-shaped thickenings and scattered spines, or spinulose. Spores yellow, reticulated with narrow, rarely with broad and pitted bands, 11 to 16 μ diam.; border 0·5 to 1·5 μ wide.—Cooke, Myx. Brit., fig. 198; Mass., Mon., p. 170. *Trichia nitens* Libert (non Pers.), Pl. Cryp. Ard., Fasc. iii., No. 227 (1834). *Cornuvia nitens* Rost., Versuch, p. 15 (1873). *Trichia Bavarica* de Thuemen, Myc. Univ., No. 1497. *Oligonema Bavaricum* Balf. & Berl., Sacc. Syll., vii., p. 437. *Perichæna flavida* Peck, in Rep. N. York Mus., xxvi., p. 76. *Oligonema flavidum* Mass., Mon., p. 171. *Oligonema brevifilum* Peck, in Rep. N. York Mus., xxxi., p. 42; Mass., Mon., p. 173. *Oligonema minutulum* Mass., in Journ. R. Micr. Soc. (1889), p. 348; Mass., Mon., p. 171. *Physarum Schweinitzii* Berk., in Grev., ii., p. 66; Mass., Mon., p. 311. *Trichia Kickxii* Rost., Mon., App., p. 40. *Trichia pusilla* Schroet., Krypt. Fl. Schles., iii., p. 114.

Plate LXI., A.—*d.* sporangia, × 20; *e.* elaters, × 600; *f.* spore, × 600 (Ardennes: Libert's type).

This species varies in the markings on the elaters and the reticulation of the spores; few gatherings are exactly similar, and great variety is often seen in a single sporangium; the length of the elaters in some specimens is only about 50 μ, while in others the average is from five to seven times as long. A gathering from South Carolina in Ravenel's collection (B. M. 960, 961) shows some sporangia with capillitium forming a network with few free ends as in *Hemitrichia*, while others have more or less branched and free elaters. *O. nitens* is allied to *Trichia affinis* and *T. persimilis*, in which species similar variations in spores and elaters are sometimes found in sporangia which have

been exposed to unusual conditions of development. *O. Bavaricum* Balf. & Berl. is described as distinguished from *O. nitens* by the more distinct spirals on the elaters, but the spirals are as distinct in Libert's type of the species; the spores of the Bavarian gathering vary in size from 12 to 16 μ, and the reticulation also varies so as to present from four to sixteen meshes on the surface of the hemisphere. The type specimens of *O. flavidum* Peck and *O. brevifilum* Peck differ from one another only in the former having more papillose and longer elaters than the latter, and spores measuring 12 to 14 μ, while in *O. brevifilum* they measure 10 to 12 μ; they scarcely differ from the specimen named *O. Bavaricum*, and are here included under *O. nitens*. The type specimens of *O. minutulum* Mass., from Algiers (B. 1739), and *Physarum Schweinitzii* Berk., from Bethlehem, U.S.A. (K. 1738), are typical *O. nitens*. The descriptions of *Trichia Kickxii* Rost. and *T. pusilla* Schroet. agree so perfectly with the character of *O. nitens* that they are here placed as synonyms of this species.

Hab. On dead wood.—Near Birmingham (L:B.M.144); Belgium (B. M. 747); Germany (Strassb. Herb.); Bavaria (B. M. 746); Algiers (K. 1739); Philadelphia (L:B.M.144); Ohio (L:B.M.144); Iowa (B. M. 1031); S. Carolina (B. M. 960, 961, 964).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **O. aeneum** Karst., Myc. Fenn., iv., in Bidr. Känn. Finl. Nat. (1879), p. 131. Sporangia densely crowded, often confluent and vein-like, rarely scattered, globose, or angled by mutual pressure, depressed, shining, metallic copper, greenish or olivaceous; capillitium tubes free, with scattered ring-shaped thickenings, 2 to 3 μ thick; spores warted, reddish- or pale yellowish-ochre, 12 μ diam.

Hab. On pine-wood.—Mustiala, Finland.

3. **O. furcatum** Bucknall, in Mass., Mon., p. 173. Sporangia scattered, globose, shining, bright chrome-yellow, as well as the capillitium and spores; elaters cylindrical, simple or branched, slightly thickened at the obtuse ends, with a faint open spiral, 3 to 4 μ diam.; spores globose, minutely warted, 11 to 12 μ diam.

Hab. On a rotting trunk.—Abbots Leigh, Somerset, England.

SPECIES EXCLUDED FROM THE GENUS.

O. Broomei Mass. = *Perichæna populina* Fr.

Genus 35.—**HEMITRICHIA** Rostafinski, Versuch, p. 14 (1873). Sporangia stalked or sessile; capillitium an elastic network of more or less branching threads, thickened with two to six spiral bands; spores minutely warted or reticulated. *HEMIARCYRIA* Rost., Mon., p. 261 (1875).

I have restored the original name which Rostafinski gave to this genus, being in accordance with the laws of botanical nomenclature, while at the same time it expresses more accurately the affinities of the group.

KEY TO THE SPECIES OF *HEMITRICHIA*.

A. Spores nearly smooth, or minutely warted :—

A. Capillitium red, spinose. 1. *H. rubiformis*

B. Capillitium yellow or yellow-brown—

a. Sporangia stalked—

Stalk solid. 2. *H. intorta*

Stalk hollow, filled with spore-like cells—

Cup papillose. 3. *H. clavata*

Cup smooth. 4. *H. leiocarpa*

b. Sporangia sessile—

Spirals of capillitium one to three, prominent, sporangium-wall membranous. 5. *H. Wigandii*

Spirals of capillitium three or more, indistinct, sporangium-wall thickened with granular deposits. 6. *H. Karstenii*

B. Spores reticulated :—

Capillitium threads spinose. 7. *H. Serpula*

Capillitium threads smooth. 8. *H. chrysospora*

1. **H. rubiformis** Lister. Plasmodium purple-red, in rotten wood. Total height 1·3 to 2·5 mm. Sporangia clavate or subcylindrical, stipitate or sessile, combined in clusters or crowded, 1 to 1·3 mm. high, 0·5 to 0·7 mm. broad, glossy or shining, dark red, red-brown, or olive-black ; sporangium-wall of two layers, the outer continued into the stalk, the inner enclosing the spores, orange-red. Stalks membranous, 0·2 to 1 mm. high, usually combined in clusters of from six to twelve, furrowed and rugose, red, not enclosing spore-like cells. Capillitium of twisting, sparingly branched, orange-red threads 5 to 6 μ diam., marked with three to five regular spiral bands, beset with numerous scattered spines 2 to 5 μ long, rarely nearly smooth, with few pointed free ends. Spores pale orange-red, warted, 10 to 11 μ diam.—*Hemiarcyria rubiformis* Rost., Mon., p. 262 ; Cooke, Myx. Brit., p. 67, figs. 201, 230, 231 ; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 13 ; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 133. *Trichia rubiformis* Pers., in Römer, N. Mag. Bot., i., p. 88 (1794). *Arcyria rubiformis* Mass., Mon., p. 158. *Trichia Neesiana* Corda, Ic., i., p. 23.

a. **genuina** : sporangia red-brown.

β. **Neesiana** Rost. : sporangia olive black.

Plate LXIII., A.—*a*. sporangia, × 20 ; *b*. capillitium and spores, × 280 ; *c*. capillitium and spore, × 600 (England).

Sporangia are occasionally found with a few free elaters pointed at each end, in addition to the continuous network of threads of the usual type.

Hab. On dead wood.—Orton, Leicester (B. M. 335, 338); Rudloe, Wilts (B. M. 340); Batheaston, Somerset (B. M. 341); Wanstead, Essex (L:B.M.145); Hampstead, London (B. M. 1123); Boynton, Yorkshire (B. M. 1126); France (K. 123); Germany (B. M. 791, 700); Italy (B. M. 789); Finland (B. M. 788); Poland (Strassb. Herb.); Iowa (B. M. 830); Texas (B. M. 956); S. Carolina (B. M. 761).

2. **H. intorta** Lister. Plasmodium watery-white. Total height 1 to 1·5 mm. Sporangia turbinate, stipitate, gregarious or scattered, 0·3 to 0·7 mm. diam., shining, yellow or olive-yellow; sporangium-wall membranous above, thickened with granular deposits towards the base, papillose on the inner side. Stalk thickened above and below, with two to four broad longitudinal furrows, 0·5 to 0·7 mm. long, 0·15 mm. thick in the middle, glossy, purplish-brown, solid, not filled with spore-like cells. Capillitium a twisted tangle of sparingly branched orange-yellow threads, 4 μ diam., marked with four to five more or less distinct, closely set, spiral bands, sometimes connected with longitudinal striæ, densely spinulose or nearly smooth. Spores yellow, minutely warted, 9 to 13 μ diam. —*Hemiarcyria intorta* List., in Journ. Bot. (1891), p. 268. *Hemiarcyria longifila* Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 396.

α. **genuina**: spirals on elaters distinct, usually spinulose; spores 9 to 10 μ.

β. **leiotricha**: spirals on elaters indistinct, smooth; spores 12 to 13 μ.

Plate LXIII., B.—*a. α. genuina*, sporangia, × 20; *b.* capillitium and spores, × 600 (England); *c. β. leiotricha*, sporangium, × 20; *d.* capillitium and spores, × 600 (England).

The var. *genuina* appeared in considerable abundance near Hitchin in March 1889 and January 1890. It was also gathered near Birmingham by Mr. Camm in October 1889, and was described in the *Journal of Botany*, September 1891. A few months later it was independently recorded in *Proceedings of the Academy of Natural Science of Philadelphia* by Dr. Rex under the name of *H. longifila*. Specimens received from Dr. Rex, and Prof. Macbride, of Iowa University, are essentially identical with the English gatherings.

The var. *leiotricha* is a form which has been met with on five occasions—three times in a larch plantation near Lyme Regis, once in a fir wood at Leighton Buzzard, and on dead leaves at Sande, Norway. In external appearance it resembles var. *genuina*; the capillitium is profuse and of a bright yellow colour. In the Lyme Regis gatherings the threads are almost smooth, with a faint indication of spiral markings; free ends are more numerous in some sporangia than in others. In the Leighton gathering the threads in some cases are nearly smooth, and more or less in the form of long branching elaters of the type of *Trichia*; in others they have the true *Hemitrichia* character, with few free ends. They are marked with distinct spirals (represented Pl. LXIII., B, fig. *d*). This form would come under the description of *H. intorta*, except in the size of the spores, which measure 12 to 13 μ. Until further material can be met with, it is placed as a variety of *H. intorta*, with which it is very closely allied. It is interesting as affording another instance of the *Trichia* and *Hemitrichia* characters being exhibited in one species, as

has also been found in *H. chrysospora*, and occasionally in *H. rubiformis*.

Hab. On dead wood.—Hitchin, Herts (L:B.M.146); Norway (L:B.M.146); Iowa (L:B.M.146).

3. **H. clavata** Rost., Versuch, p. 14 (1873). Plasmodium watery-white, in dead wood. Total height 1 to 3 mm. Sporangia clavate or turbinate, rarely globose, stalked, gregarious, 0·7 to 1·5 mm. high, shining, ochraceous or olivaceous-yellow; sporangium-wall membranous, minutely papillose on the inner side, yellow. Stalk cylindrical, 0·3 to 1·5 mm. long, furrowed or nearly even; olive, red-brown, or nearly black; hollow, filled with spore-like cells. Capillitium a network of yellowish-olive, branched threads, 5 to 6 μ diam., marked with five to six well-defined spiral bands 1 μ wide, with intervals of 1 to 1·5 μ, usually velvety in profile, sometimes spinose in parts in imperfect developments; free ends rounded, either few or numerous. Spores ochraceous, minutely warted, 8 to 10 μ diam.—*Hemiarcyria clavata* Rost., Mon., p. 264 (1875); Cooke, Myx. Brit., p. 68; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 13; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 134. *Trichia clavata* Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). *Arcyria clavata* Mass., Mon., p. 165. *Hemiarcyria stipitata* Mass., in Journ. R. Micr. Soc. (1889), p. 354. *Arcyria stipitata* Mass., Mon., p. 163. *Arcyria decipiens* Berk., in Ann. Mag. Nat. Hist., Ser. 1, ix., p. 447.

Plate LXIV., A.—*a.* sporangia, × 20; *b.* capillitium, × 600; *c.* spores, × 600 (England); *d.* sporangia developed in cold weather, × 20; *e.* capillitium of same, beset with spines appearing in limited tracts among threads of the usual form, *b*, × 600 (United States); *f.* a portion of the papillose sporangium-wall, × 600; *g.* sporangium with expanded capillitium, × 20 (United States).

The type specimen of *Arcyria stipitata* Mass., from Java (K. 1768), is an unusually long stalked but typical form of *H. clavata*, apparently without free ends to the capillitium. The type of *Arcyria decipiens* Berk., collected by Charles Darwin at Rio Janeiro (K. 1766), is typical *H. clavata*.

Hab. On dead wood.—Batheaston, Somerset (B. M. 354); Dudley, Stafford (L:B.M.147); Lyme Regis, Dorset (L:B.M.147); France (K. 134); Germany (B. M. 792, 794); Poland (Strassb. Herb.); Natal (K. 148); Ceylon (K. 1765); Java (K. 1768); Borneo (L:B.M.147); Bonin Islands (K. 138); Philadelphia (L:B.M.147); Iowa (B. M. 831, 1024, 1031); S Carolina (B. M. 796); Cuba (K. 1765A); Venezuela (K. 1767); Rio Janeiro (K. 1766); French Guiana (Paris Herb.); Paraguay (Paris Herb.); Chili (Paris Herb.).

4. **H. leiocarpa** Lister. Plasmodium? Total height 1·5 mm. Sporangia obovoid, rarely subglobose, pale grey or ochraceous-grey, 0·7 mm. diam.; sporangium-wall evanescent above; the cup membranous, smooth, colourless, longitudinally plicate, minutely and transversely wrinkled. Stalk 0·7 mm. long, 0·05 mm. thick, furrowed, ochraceous-grey, containing spore-like cells. Capillitium

a network of frequently branching pale grey threads, 2 to 5 μ thick, marked with three to five often prominent spiral bands, sometimes smooth, but in many parts beset with numerous spines about 2 μ long; free ends subclavate, usually spinulose. Spores smooth, pale grey in mass, 6 to 8 μ diam.—*Hemiarcyria leiocarpa* Cooke, in Ann. Lyc. Nat. Hist. N. York, xi., p. 405 (1877); Myx. Brit., p. 88, figs. 252, 255. *Hemiarcyria Varneyi* Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 396.

Plate LXIV., B.—*a*. sporangia, × 20; *b*. portion of cup of sporangium-wall, × 600; *c*. capillitium, × 600; *d*. spore, × 600 (Maine, U.S.A.: part of type).

This species is closely allied to *H. clavata*, differing in the pale colour, in the smooth colourless sporangium-wall, the smooth spores, and in the spinose tracts of the capillitium, which in *H. clavata* is an exceptional character. *H. Varneyi* Rex has a more elongated sporangium and a shorter stalk; but, in comparing the specimen kindly furnished by Dr. Rex with the type of *H. leiocarpa*, the other characters appear to be identical.

Hab. On dead wood.—Maine, U.S.A. (L:B.M.147A); Kansas (L:B.M.147A *slide*).

5. **H. Wigandii** Lister. Plasmodium rose-red. Sporangia subglobose or turbinate, sessile, rarely shortly stalked, crowded or gregarious, 0·4 to 0·7 mm., opaque or shining, yellow, yellow-brown, or ochraceous; sporangium-wall membranous, yellow, smooth. Capillitium a tangle of sparingly branched, ochraceous-yellow threads, 3 to 5 μ diam., marked with one to three prominent bands, forming an irregular loose spiral, with few rounded or bulbous free ends. Spores yellow, minutely warted, 9 to 12 μ diam.—*Hemiarcyria Wigandii* Rost., Mon., p. 267 (1875); Cooke, Myx. Brit., fig. 232. *Acryria Wigandii* Mass., Mon., p. 163. *Trichia nana* Mass., in Journ. R. Micr. Soc. (1889), p. 336; Mass., Mon., p. 181.

Plate LXIV., B.—*e*. sporangia, × 20; *f*. capillitium, × 600; *g*. spore, × 600 (Germany: Rostafinski's type); *h*. sporangia, × 20 (United States).

The type specimen of *Trichia nana* Mass., from Westbrook, Maine (K. 1164), is *H. Wigandii*, agreeing perfectly with Rostafinski's type from Freiburg in the loose capillitium, with one or two lax and irregular spiral bands; the sporangia measure 0·3 to 0·5 mm. diam. In extensive gatherings made in Norway, on fir wood, some sporangia have short slender stalks filled with spore-like cells.

Hab. On dead wood.—Germany (Strassb. Herb.); Norway (L:B.M. 148); Mass., U.S.A. (L:B.M.148); Maine (K. 1164).

6. **H. Karstenii** Lister. Plasmodium? Sporangia forming elongated, curved plasmodiocarps, 0·3 to 0·5 mm. broad, or subglobose, sessile; pale brown, red, or purplish-brown; mass of capillitium and spores yellow or orange-red; sporangium-wall thickened with deposits of granular matter. Capillitium a tangle of branching yellowish or reddish-brown threads, 3 to 5 μ diam.,

marked with three to five indistinct spiral bands, often with scattered ring-shaped thickenings and irregular expansions; free ends pointed or blunt. Spores yellow, minutely warted, 9 to 15 μ diam.—*Hemiarcyria Karstenii* Rost., Mon., App., p. 41 (1876). *Arcyria Karstenii* Mass., Mon., p. 168. *Hemiarcyria paradoxa* Mass., in Journ. R. Micr. Soc. (1889), p. 356. *Arcyria paradoxa* Mass., Mon., p. 160. *Hemiarcyria obscura* Rex, in Proc. Acad. Nat. Sc. Phil. (1891), p. 395.

Plate LXV., A.—*a.* plasmodiocarp, × 20; *b.* portion of sporangium-wall, showing the granular outer and membranous inner layers, × 280; *c.* capillitium and spores, × 280; *d.* capillitium, × 600; *e.* spore, × 600 (England).

This species appears to be a Hemitrichia form of *Trichia contorta*, which it resembles in every respect, except that the capillitium threads are combined instead of forming free elaters; the same variety in shape and colour of the sporangia, and in the markings and colour of the capillitium, occur as in that species. Rostafinski's type specimen from Ceylon (K. 1773) has pale yellow-brown sporangia and rugged capillitium, with faint spirals and many large rounded expansions; the spores are yellow, minutely warted, and measure 10 to 11 μ diam. Specimens from near Dudley, found by Mr. Camm, have both globose and plasmodiocarp purple-brown sporangia and orange-brown capillitium, strongly contrasting with the yellow spores. The type specimen of *Arcyria paradoxa* Mass., from Weybridge(K. 132), closely resembles the Ceylon gathering of *H. Karstenii*, only differing in the more regular, less branched capillitium, with fewer expansions; it must therefore be included under that species. The mounting of *Hemiarcyria obscura* Rex, *l.c.* (L:B.M.149), furnished by Dr. Rex, shows a dull yellowish-red capillitium; the threads are 2·5 to 3 μ thick, and are marked with close faint spirals; they have nearly the same colour as those of the Dudley specimen, but are more uniform, with inconspicuous swellings; the spores are similar to those of the type of *H. Karstenii* at Kew, and there appears to be no specific character to separate it from that species.

Hab. On dead leaves.—Dudley, Stafford (L:B.M.149); Weybridge, Surrey (K. 132); Ceylon (K. 1773); Montana, U.S.A. (L:B.M.149 *slide*).

7. **H. Serpula** Rost., Versuch, p. 14 (1873). Plasmodium? Sporangia forming elongated, winding, branched plasmodiocarps, 0·4 to 0·6 mm. wide, usually combined to form a close net, golden-yellow; sporangium-wall of two layers, yellow. Capillitium a tangle of twisting, sparingly branched, yellow threads, 5 to 6 μ diam., marked with three to four well-defined regular spiral bands 0·7 μ wide, with intervals of 1 to 2 μ, strongly spinose; longitudinal striæ often distinct; free ends pointed. Spores yellow, reticulated with narrow bands, forming a net with about nine meshes to the hemisphere, 10 to 12 μ diam.; border 0·5 to 1 μ wide.—*Hemiarcyria Serpula* Rost., Mon., p. 266 (1875); Cooke, Myx. Brit., p. 68, figs. 200, 227, 228; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 135. *Mucor Serpula* Scop., Fl. Carn., Ed. 2, ii., p. 493 (1772). *Trichia Serpula* Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). *Arcyria Serpula* Mass., Mon., p. 164.

Plate LXVI., A.—*a*. plasmodiocarp, × 20 ; *b*. capillitium, × 600 ; *c*. spore, × 600 (Scotland).

Hab. On dead wood.—In hothouse, Glasgow (Edinburgh Herb.) ; Germany and Poland (Strassb. Herb.) ; Bombay (B. M. 797) ; Ceylon (B. M. 802) ; New Zealand (K. 131) ; Philadelphia (L:B.M.150) ; Iowa (B. M. 832) ; S. Carolina (B. M. 801) ; St. Vincent (K. 133) ; French Guiana (Paris Herb.).

8. **H. chrysospora** Lister. Plasmodium ? Sporangia subglobose, sessile, crowded or scattered, 0·5 to 1 mm. diam., glossy, bright yellow ; sporangium-wall membranous, with minute thickenings in the form of a broken irregular reticulation. Capillitium a network of branching, yellow threads, 5 μ diam., with four to five narrow bands arranged in a close, regular spiral, and connected by longitudinal striæ ; the threads provided with many shortly pointed free ends, and attached to various parts of the sporangium-wall. Spores yellow, reticulated with narrow, sharply defined bands, forming a regular net with six to nine meshes to the hemisphere, 16 to 18 μ diam. ; border 1·5 to 2 μ broad.—*Hemiarcyria chrysospora* Lister, in Grev., xv., p. 126 (1887) ; Mass., in Journ. R. Micr. Soc. (1889), p. 357. *Arcyria chrysospora* Mass., Mon., p. 164.

Plate LXV., B.—*a*. sporangia, × 20 ; *b*. capillitium, × 600 ; *c*. spore × 600 (England).

This species was first found on fallen twigs and moss in a larch plantation near Lyme Regis, November 1886. A small gathering was obtained in another larch plantation near the same place in November 1890, agreeing in all respects with the above, except that the capillitium consisted of long free elaters.

Hab. On dead twigs.—Lyme Regis, Dorset (L:B.M.151).

SPECIES REFERRED TO *HEMIARCYRIA*, NOT MET WITH IN THE QUOTED COLLECTIONS.

9. **H. calyculata** Speg., in Annal. Soc. Cient. Argent., x., p. 152 (1880). Sporangia simple, gregarious, stipitate, globose or ellipsoid, 1 to 2 mm. diam., dull fulvous-brown. Stalk 2 to 5 mm. long, 0·2 to 0·25 mm. thick, terete, glabrous, firm, expanded above into a cup which is half the height of the sporangium, the base expanded, fibrillose, concolorous. Capillitium and spores dull yellow ; elaters 7 to 8 μ thick, branches few, with pointed free ends, cylindrical ; spiral bands three to five, even, somewhat inconspicuous, with interspaces of equal width, spinulose. Spores discoid-lenticular, margin muricate, 10 × 3 μ.

Hab. On dead willow.—Argentine Republic.

This description suggests a form of *Hemitrichia clavata*.

10. **H. melanopeziza** Speg., *l.c.*, xii., p. 257 (1881). Sporangia sessile, creeping, subterete, usually forming rings, 1 to 2 mm.

long, black, scarcely or not at all shining, smooth; wall black, opaque, subcellular, subcoriaceous, splitting longitudinally and dehiscing in a valvate manner. Capillitium yellow or citron-yellow, protruded elastically; threads terete, 4 to 5 μ diam., combined into a loose net, everywhere covered with erect spines 5 to 6 × 1 μ, spirals obsolete. Spores elliptic-globose, papilloso-scabrid, 10 to 12 μ, yellow.

Hab. On bark.—Brazil.

This description applies well to *Perichæna chrysosperma* List.

11. **H. pusilla** Speg., *l.c.*, xii., p. 257 (1881). Sporangia rather closely gregarious, subcylindrico-elliptical, 0·4 to 0·5 mm. high, 0·15 to 0·25 mm. diam., obtuse above, truncate below, stem almost or entirely wanting; at first amber-red, then rose-colour. Capillitium forming a rather dense network of terete rose-coloured threads, 3 to 4 μ thick; spirals three or four, furnished with minute spinules. Spores rose or flesh-coloured, globose, smooth, 7 to 9 μ diam.

Hab. On bark.—Argentine Republic.

SPECIES EXCLUDED FROM THE GENUS.

Hemiarcyria stipata Rost. = *Arcyria stipata* List.
Hemiarcyria applanata Cooke & Mass. = *Perichæna depressa* Lib.

Genus 36.—**CORNUVIA** Rostafinski, Versuch, p. 15 (1873). Sporangia sessile; capillitium a network of threads with thickenings in the form of simple rings; spores reticulated.

1. **C. Serpula** Rost., Versuch, p. 15 (1873). Plasmodium? Sporangia forming curved or branched plasmodiocarps, about 0·3 mm. broad, or subglobose, sessile, golden-yellow; sporangium-wall membranous, pale yellow. Capillitium a network of freely branching yellow threads, 3 to 5 μ diam., marked with well-defined, prominent ring-shaped thickenings, arranged at intervals of about 2 μ or irregularly scattered; junctions of the branches without thickenings. Spores yellow, reticulated with narrow bands forming a net with from eight to twelve meshes to the hemisphere, 10 to 12 μ diam.; border 0·5 to 1 μ broad.—Rost., in Fuckel, Symb. Myc., Nachtr. 2, p. 76 (1893); Rost., Mon., p. 239; Cooke, Myx. Brit., fig. 189. *Arcyria Serpula* Wigand, in Pringsh., Jahrb., iii., p. 44 (1863). *Ophiotheca Serpula* Mass., Mon., p. 135.

Plate LXVI., A.—*d.* plasmodiocarp, × 20; *e.* capillitium, × 600; *f.* spore, × 600 (Germany).

Hab. On tan.—Germany (B. M. 784 and Strassb. Herb.).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **C. dictyocarpa** Krupa, in Cosmos, p. 377 (1886). Related to *C. circumscissa* Rost. (*Perichænia chrysosperma* Lister), but

differs in the inner sporangium-wall being furnished with depressed thickened lines, and breaking up, when mature, into quadrangular or pentagonal fragments.

Hab. On dried roots of *Robinia*.—Poland.

This species is referred to in *Hedwigia*, 1887, p. 110, by Raciborski, as being indistinguishable in the description from *C. circumscissa* ; the structure of the sporangium-wall suggests rather *Perichæna populina* or *P. depressa*.

3. **C. anomala** Karst., in Bidr. Känn. Finl. Nat. (1879), iv., p. 131. Sporangia scattered or gregarious, sessile, subglobose, dirty ochraceous, shining, 1·5 mm. diam. Tubes of the capillitium 4 to 6 μ diam., cylindrical, with numerous truncate, often clavate, free ends, provided with close-set, ring-shaped thickenings. Spores globose, smooth, dull ochre, or pale yellow, 6 to 7 μ diam.—*Trichia anomala* Karst., in Not. Sällsk. Faun. Flor. Fenn., ix., p. 354 (1868).

Hab. On bark and wood of pine.—Finland.

The numerous free ends and ring-shaped thickenings of the elaters and the smooth spores suggest that this is an irregular form of *Trichia scabra*.

4. **C. leocarpoides** Speg., in Ann. Soc. Cient. Argent., xii., p. 256 (1881). Sporangia subglobose or pyriform, 0·6 to 0·8 mm. diam., yellowish-red or fulvous, not or scarcely shining, smooth ; the wall rather thick, subcartilaginous, soon evanescent above, often forming a persistent cup below. Stalk rigid, erect, brown or blackish, slender, smooth or subrugulose, hardly exceeding the diameter of the sporangium. Capillitium elastically protruding, adnate at the base, long persistent, tobacco-coloured or fulvous-olive ; threads slender, 5 to 6 μ thick, forming a dense net with many terete, rounded-truncate free ends ; spiral bands three or four, smooth, not papillose. Spores globose, smooth, filled with granules, fulvous-olivaceous, 8 to 10 μ diam.

Hab. On rotten wood.—Apiahy, Brazil.

This description applies well to a form of *Hemitrichia clavata* with many free ends to the capillitium.

SPECIES EXCLUDED FROM THE GENUS.

C. circumscissa Rost. = *Perichæna chrysosperma* List.
C. depressa List. = *Dianema depressa* List.
C. metallica Rost. = *Margarita metallica* List.
C. Wrightii Rost. = *Perichæna chrysosperma* List.

Order II.—ARCYRIACEÆ. Sporangia simple, stalked or sessile ; capillitium combined into an elastic network, with thickenings in the form of half-rings, cogs, spines, or warts.

KEY TO THE GENERA OF *ARCYRIACEÆ*.

Sporangia stalked; sporangium-wall evanescent above, persistent and membranous in the lower third. (37) ARCYRIA.

Fig. 45.—*Arcyria punicea* Pers.
a. Group of sporangia. Twice natural size.
b. Capillitium. Magnified 250 times.
c. Spore. Magnified 560 times.

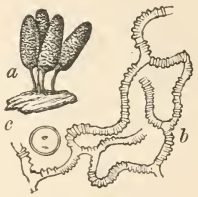

Fig. 45.

Sporangia sessile, clustered; sporangium-wall single, persistent, papillose, not thickened with angular granules. (38) LACHNOBOLUS.

Fig. 46.—*Lachnobolus circinans* Fries.
a. Cluster of sporangia. Twice natural size.
b. Capillitium and spore. Magnified 300 times.

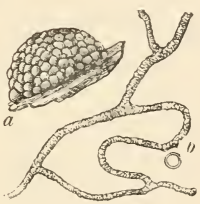

Fig. 46.

Sporangia sessile or plasmodiocarps; sporangium-wall double, at least at the base; the outer layer thickened with dark angular granules. (39) PERICHÆNA.

Fig. 47.—*Perichæna populina* Fries.
a. Group of sporangia. Magnified 7 times.
b. Capillitium and spore. Magnified 280 times.

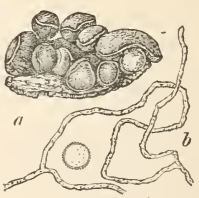

Fig. 47.

Genus 37.—**ARCYRIA** Hill, Nat. Hist., ii., p. 47 (1751). Sporangia stalked; sporangium-wall evanescent above, persistent as a membranous cup in the lower third; stalk filled with spores or spore-like cells; capillitium with thickenings in the form of half-rings, cogs, spines, or broken reticulation, rarely with faint spirals in addition.

KEY TO THE SPECIES OF *ARCYRIA*.

A. Spores 9 to 11 μ diam., sporangia orange-red or buff:—

Sporangia ovoid, wall reticulated. 1. *A. ferruginea*

Sporangia clavate, wall papillose. 2. *A. versicolor*

B. Spores 6 to 8 μ diam.:—

a. Capillitium attached to the cup—

Capillitium closely spinulose, grey, or yellowish-grey. 3. *A. albida*

Capillitium marked with cogs and half-rings; sporangia red, ovoid, or subcylindrical. 4. *A. punicea*

Capillitium marked with transverse bands and minute spines; sporangia flesh-coloured, turbinate, small. 5. *A. insignis*

b. Capillitium free from the cup—

a. Network of capillitium expanding, not drooping—

Capillitium marked with cogs and spines. 6. *A. incarnata*

Capillitium marked with cogs, spines, and three to four indistinct spiral bands in addition. 7. *A. stipata*

b. Network of capillitium much elongated, drooping—

Sporangia buff; wall evanescent above. 8. *A. flava*

Sporangia red; wall persistent above in shield-like fragments. 9. *A. Ærstedtii*

1. **A. ferruginea** Sauter, in Flora, xxiv., p. 316 (1841). Plasmodium rose-red, in rotten wood. Total height 1 to 2 mm. Sporangia ovoid, stipitate, crowded, 0·7 to 1·3 mm. high, 0·5 to 1 mm. broad, orange-red, or more rarely pale ochraceous; cup of sporangium even, shining, funnel-shaped, or at length nearly flat, marked with round-meshed reticulations on the inner side. Stalk cylindrical, 0·3 to 0·8 mm. long, 0·05 to 0·15 mm. thick, red, rarely white, arising from a well-developed membranous hypothallus; filled with spore-like cells. Capillitium an elastic network of freely branching yellow-brown threads, 5 to 8 μ diam., diminishing to 2 to 3 μ diam. towards the base, triangular or oval in section, thickened on one side with transverse bars or reticulations, on the other two sides marked with a broken reticulation or with warts, often spinulose throughout; a few sparingly branched slender threads penetrate the tube of the stalk without attachments to the cup; free ends with rounded or pointed tips are not unfrequent, but often wanting. Spores pale red or ochraceous, faintly and closely warted, 8 to 11 μ diam.—Rost., Mon., p. 279; Cooke, Myx. Brit., p. 73, fig. 194; Blytt, Bidr.

K. Norg., Sop. iii. (1892), p. 11 ; Mass., Mon., p. 144. *Arcyria intricata* Rost., Mon., App., p. 37. *Arcyria dictyonema* Rost., Mon., p. 279 ; Cooke, Myx. Brit., fig. 195 ; Mass., Mon., p. 154. *Heterotrichia Gabriellæ* Mass., Mon., p. 140. *Arcyria macrospora* Peck, in Rep. N. York State Mus., xxxiv., p. 43 (1881) ; Durant, in Bot. Gaz., xix., p. 89.

Plate LXVI., B.—*a*. sporangia, × 20 ; *b*. portion of sporangium-wall, × 600 ; *c*, *d*. threads of upper part of capillitium, × 600 ; *e*. thread of basal part of capillitium, × 600 (England) ; *f*. capillitium of type of *A. dictyonema* Rost. × 600 (Germany) ; *g*. capillitium of type of *Heterotrichia Gabriellæ* Mass. × 600 (United States).

This species varies considerably in the markings on the capillitium ; the network of a single sporangium may in some parts be conspicuously thickened on one side ; in other parts the threads may appear nearly uniformly spinulose. In the type specimen of *A. dictyonema* Rost., from Freiburg, in Strassburg Herbarium, the capillitium is spinose, principally on one side of the thread, with broken reticulation and spinules on the other part ; there are numerous free branches with clavate or pointed ends ; except that the spines are more developed than usual, the markings do not differ from those frequently seen in typical *A. ferruginea*, of which it must be considered a form. The type specimen of *Heterotrichia Gabriellæ* Mass., from S. Carolina (K. 838), differs from *A. ferruginea* only in the numerous pointed free ends in the upper part of the net of the capillitium ; the threads are flattened, very closely reticulate and spinulose, and in many places thickened on one side ; the spores measure 10 to 11 μ. The abundance or scarcity of free ends varies much in different gatherings of *A. ferruginea*, and is not a sufficient character on which to base a species. *A. macrospora* Peck appears from the description to differ in no respect from typical *A. ferruginea*.

Hab. On dead wood.—Leytonstone, Essex (L:B.M.153) ; Lyme Regis, Dorset (L:B.M.153) ; Leighton, Beds (L:B.M.153) ; Henllys, Anglesey (B. M. 1130) ; France (K. 921) ; Germany (B. M. 727) ; Norway (Christiania Herb.) ; Australia (K. 848) ; Mass., U.S.A. (L:B.M.153) ; S. Carolina (B. M. 966).

2. **A. versicolor** Phillips, in Grev., v., p. 115 (1877). Plasmodium ? Total height 2·5 to 3 mm. Sporangia pyriform or clavate, shortly stipitate or sessile, gregarious, 1 to 2 mm. diam., more or less shining, yellow or olivaceous-yellow ; sporangium-wall membranous, persistent except at the apex, yellow, papillose on the inner side. Stalk membranous, 0·2 mm. long, yellow-brown, filled with spore-like cells, arising from a well-developed hypothallus. Capillitium an elastic network of freely branching yellow threads, 4 to 6 μ diam., triangular or oval in section, either uniformly spinulose and marked with broken reticulation, or one side thickened and marked with transverse bars ; the threads arise from the tube of the stem, and are not attached to the sporangium-wall ; free ends shortly pointed. Spores yellow, smooth, 8 to 10 μ diam.—Mass., Mon., p. 149. *Arcyria vitellina* Phill., *l.c.*, p. 115.

Plate LXVII., A.—*a*. sporangia, × 20 ; *b*. portion of sporangium-wall, × 600 ; *c*. capillitium and spore, × 600 (California).

This species is represented by two gatherings from California by Dr. Harkness (K. 839, 897); in one the sporangia and capillitium are bright yellow, in the other dull yellow; they received respectively the names *A. vitellina* Phill. and *A. versicolor* Phill., but as they agree in other respects they are united under the latter name. *A. versicolor* is closely allied to *A. ferruginea*, from the pale form of which it only differs in shape, in the papillose thickenings of the sporangium-wall, and the smoother spores.

Hab. On dead wood.—California (L:B.M.154).

3. **A. albida** Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). Plasmodium grey, in rotten wood. Total height 0·8 to 4 mm. Sporangia ovoid, more rarely globose or cylindrical, stipitate, erect, 0·5 to 1·2 mm. diam., pale grey or greyish flesh-colour, sometimes dull yellow; cup of the sporangium-wall membranous, smooth or minutely papillose, plaited at the base, pale grey or yellowish. Stalk cylindrical, furrowed, 0·2 to 2 mm. long, 0·05 to 0·15 mm. thick, dark grey or brown, hollow, filled with spore-like cells. Capillitium a close network of grey or yellowish-grey threads; the outer threads 2 μ, rarely 4 μ thick, closely warted or spinulose, those composing the inner part of the network 4 to 6 μ thick, smooth or minutely warted, with numerous attachments to the cup. Spores marked with a few scattered warts, 6 to 7 μ diam.—*Trichia cinerea* Bull., Champ., p. 120 (1791). *Stemonitis cinerea* Gmel., Syst. Nat., p. 1467. *Arcyria cinerea* Pers., Syn. Fung., p. 184 (1801); Schum., En. Pl. Saell., ii., p. 213 (1803); Rost., Mon., p. 272; Cooke, Myx. Brit., p. 71, figs. 182, 183, 184, 185, 193; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 11; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 123; Mass., Mon., p. 151. *Arcyria stricta* Rost., Mon., App., p. 36. *Arcyria pomiformis* Rost., Mon., p. 271; Cooke, Myx. Brit., p. 70. *Arcyria Friesii* Berk. & Br., in Ann. Mag. Nat. Hist., Ser. 4, xvii., p. 140; Cooke, Myx. Brit., p. 71, fig. 259. *Stemonitis digitata* Schwein., Trans. Am. Phil. Soc., New Ser. 4, p. 260. *Arcyria digitata* Rost., Mon., p. 274; Mass., Mon., p. 153. *Arcyria globosa* Schwein., in Comm. Soc. Nat. Cur. Lips., i., p. 66. *Lachnobolus globosus* Rost., Mon., p. 283; Mass., Mon., p. 137. *Arcyria Cookei* Mass., Mon., p. 154.

α. **genuina**: sporangia ovoid, grey.

β. **pomiformis**: sporangia globose, yellow.—*A. pomiformis* Rost.

γ. **globosa**: sporangia globose, white or pale ochraceous.—*Lachnobolus globosus* Rost.

Plate LXVII., B.—*a*, *b*. sporangia, × 20; *c*. globose sporangium on bramble, × 20; *d*, *d'*. outer capillitium of *a*, often with half-rings and coarse spines on one side, *d* × 280, *d'* × 600; *e*, *e'*. outer capillitium of the more usual form, with minute spines equally distributed; and smooth thread attached to sporangium-wall, *e* × 280, *e'* × 600; *f*. spore, × 600 (England); *g*. sporangium of *Lachnobolus globosus* Rost., on chestnut bur, × 20; *h*. capillitium of same, × 600 (United States); *i*. sporangium of *Lachnobolus globosus* var. *minor* Ellis, on male flower of chestnut, × 20 (United States).

This species is very variable in the shape of the sporangia. An extensive growth of the common grey form, arising from one development of plasmodium, will often exhibit much diversity; subglobose sporangia with short stalks and subcylindrical sporangia with long stalks are found in company with the more usual ovoid form, either single, or combined in clusters of two to five, and then correspond with *A. digitata* Rost. Groups are also met with on dead bramble stems in which the nearly white sporangia are shortly stalked and perfectly globose, 0·5 to 0·7 mm. diam.; but these are associated with other groups, showing all degrees of difference from subglobose to ovoid. Specimens from North and South America and from the tropics are usually elongated or cylindrical. The marking on the capillitium is also a variable character. In some gatherings of the grey form the threads are nearly uniform throughout, and either almost smooth, or spinulose, with the spines minute and equally distributed, or 1 to 2 μ long, either sharp-pointed or thickened at the apices; in other gatherings the threads are broad and papillose, as in *Lachnobolus circinans*. *A. pomiformis* Roth. has yellow globose sporangia and slender stalks, but the capillitium in the type specimens in Strassburg Herbarium does not differ, except in colour, from that frequently met with in the grey form. *A. globosa* Schwein. (*Lachnobolus globosus* Rost.) appears to be a variety of *A. albida* occurring on the burs and catkins of chestnut in the United States: the globose sporangia measure 0·3 to 0·5 mm. diam., and are nearly white or pale ochraceous; the stalks are slender, one to one and a half times the length of the sporangium; the capillitium and spores resemble those of *A. albida* in all respects. Specimens received from Dr. Rex represent two varieties: one is confined to the burs of chestnut; the other, named var. *minor* by Ellis, is smaller, with longer stalks, and grows exclusively on the catkins. These forms on chestnut seem to be constant in shape; in English gatherings, however, the form growing on bramble stems has usually a marked character, differing from those found on stumps in the more globose and smaller sporangia with short stalks, and though these characters are less constant than those of the American gatherings, it would appear that the latter may owe their shape to the special substances on which they grow, and are not specifically distinct from *A. albida*. The type specimen of *A. Friesii* Berk. & Br. (K. 896) is the grey ovoid form of *A. albida*, with typical capillitium and spores. *A. digitata* Rost. is the cylindrical form of *A. albida*, with sporangia mostly in clusters of three to seven together; the stalks usually equal the sporangia in length, and, though adhering, are easily separable; the "*botrytis*" arrangement cannot be viewed as having any specific value. The type of *A. Cookei* Mass., from Brazil (Trail—K. 865), is a tall grey form of *A. albida*; the sporangia measure 2 mm. in length, 0·5 mm. in breadth; the stalks are 2 mm. long, 0·1 mm. thick; the capillitium and spores are quite typical.

Hab. On dead wood, etc.—*a.* Batheaston, Somerset (B. M. 276, 281); β. Batheaston (B. M. 278); *a.* Lyme Regis, Dorset (L:B.M.155); *a.* Sibbertoft, Northants. (K. 896); *a.* France (K. 859); *a.* Germany (B. M. 713); *a.* and β. Poland (Strassb. Herb.); *a.* Cape (K. 858); *a.* Japan (K. 866); *a.* Borneo (L:B.M.155); *a.* Australia (B. M. 714); Tonga Tabu (L:B.M.155); β. New Jersey (K. 877); *a.* Iowa (B. M. 828); γ. Philadelphia (L:B.M.155); γ. Ohio (K. 882); *a.* S. Carolina (B. M. 972, 976); *a.* Cuba (B. M. 716); *a.* Nicaragua (B. M. 1030); *a.* Venezuela (B. M. 715); *a.* French Guiana (Paris Herb.); *a.* Brazil (K. 865).

4. **A. punicea** Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). Plasmodium white, in rotten wood. Total height 2 to 3 mm. Sporangia ovoid or subcylindrical, stipitate, crowded or gregarious, 0·9 to 1·8 mm. high, 0·8 to 1 mm. broad, crimson; cup of sporangium-wall membranous, firm, shining, plaited, smooth or marked with faint broken reticulations on the inner side. Stalk cylindrical, 0·5 to 1 mm. high, 0·1 mm. thick, furrowed, red-brown, filled with spore-like cells. Capillitium a regular elastic network of flattened or terete red threads, 3 to 5 μ diam., with thickenings in the form of prominent cogs or spines, and half-rings or rings arranged in a loose spiral; with many attachments to the cup, and usually without free ends. Spores pale red, nearly smooth, but with a few scattered warts, 6 to 8 μ diam.—Rost., Mon., p. 268; Cooke, Myx. Brit., p. 69, fig. 197; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 11; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 123; Mass., Mon., p. 142. *Arcyria vernicosa* Rost., Mon., App., p. 36.

Plate LXVIII., A.—*a*. sporangia, × 20; *b*. capillitium and spore, with portion of sporangium-wall, × 600 (England).

The specimen named *A. fusca* Fr., in Fuckel, Fung. Rhen. 1443 (B. M. 708), appears to be a weathered but typical form of *A. punicea*; if this gathering is identical with Fries's type, it confirms the opinion of Rostafinski, who gives the name as a synonym for *A. punicea*.

Hab. On dead wood. Common.—Batheaston, Somerset (B. M. 254, 269); Epping Forest, Essex (L:B.M.156); Lyme Regis, Dorset (L:B.M.156); Abbey Wood, Kent (B. M. 1153); Highgate (B. M. 1149) and Hampstead (B. M. 1150); Glaisdale, Yorkshire (B. M. 1146); France (B. M. 707); Germany (B. M. 708); Poland (Strassb. Herb.); Italy (B. M. 705); Cape (K. 898); Java (K. 1715); Borneo (L:B.M.156); New Zealand (K. 931); New York, U.S.A. (K. 908); Iowa (B. M. 1029); S. Carolina (B. M. 982); S. Domingo (Paris Herb.); Cuba (K. 950); New Granada (K. 1724); French Guiana (Paris Herb.); Brazil (K. 899).

5. **A. insignis** Kalchbr. & Cooke, in Grev., x., p. 143 (1882). Plasmodium? Total height 0·5 mm. Sporangia ovoid, stipitate, gregarious, 0·3 mm. diam., red; cup of sporangium-wall delicately membranous, plaited, spinulose. Stalk thickened upwards, furrowed, 0·2 mm. long, red, filled with spores or spore-like cells. Capillitium a delicate elastic network of almost colourless threads, varying in width from 2 to 5 μ, flattened, with thickenings in the form of faint transverse bands and short spines arranged in a lax spiral, closely and minutely spinulose elsewhere. Spores almost colourless, nearly smooth, 6 to 8 μ diam.—Mass., Mon., p. 148.

Plate LXVIII., A.—*c*. sporangia, × 20; *d*. capillitium and spores, with portion of sporangium-wall, × 600 (Cape).

There are two specimens of this form in the Kew Herb., one, the type, from the Cape (Kalchbrenner—K. 895), and one marked "*A. punicea*, Natal" (K. 949). They resemble a minute form of *A. incarnata*, but the delicate capillitium attached to the cup of the sporangium-wall appears to mark it as distinct.

Hab. On dead wood.—Cape of Good Hope (K. 895, 949 ; L:B.M.157 *slide*).

6. **A. incarnata** Pers., Obs. Myc., i., p. 58 (1796). Plasmodium white, in rotten wood. Sporangia subcylindrical or ellipsoid, stipitate or nearly sessile, crowded, 1 to 1·5 mm. high, 0·6 mm. broad, flesh-coloured, more rarely red; cup of sporangium-wall membranous, even or interruptedly plicate, spinulose. Stalk weak, 0·1 to 0·3 mm. long, flesh-coloured, filled with spore-like cells. Capillitium a very loose elastic network of pale pink threads, 3 to 5 μ diam., sparingly and somewhat irregularly branched, with here and there broad perforated or ring-like expansions, often swollen at the axils of the branches; thickenings in the form of sharp cogs, half rings, or spines arranged as a border or in a loose spiral, and of minute scattered spinules; free ends present, more or less numerous, clavate or pointed, spinose. Spores pale flesh-coloured, smooth or with a few scattered warts, 6 to 8 μ diam.—Rost., Mon., p. 275; Cooke, Myx. Brit., p. 71, figs. 187, 199; Mass., Mon., p. 145. *Stemonitis incarnata* Pers., in Gmel., Syst. Nat., p. 1467 (1791). *Clathrus adnatus* Batsch, Elench. Fung., p. 141 (1783). *Arcyria adnata* Rost., Mon., App., p. 36; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 11; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 124.

Plate LXVIII., B.—*a*. sporangia, × 20; *b*. capillitium, with portion of sporangium-wall, and spores, × 280; *c*. spore, × 600 (England).

This species is closely allied to *A. punicea*, from which it is chiefly distinguished by the capillitium having free ends and being without attachments to the cup, and by the more diffusely expanding net; but intermediate forms are of not infrequent occurrence.

Hab. On dead bark, sticks, etc.—Lyme Regis, Dorset (L:B.M.158); Luton, Beds (L:B.M.158); Batheaston, Somerset (B. M. 270); Edinburgh (K. 886); France (Paris Herb.); Germany (B. M. 719); Finland (B. M. 704A); Poland (Strassb. Herb.); Australia (K. 892); Philadelphia (L:B.M.158); S. Carolina (K. 843).

7. **A. stipata** Lister. Plasmodium? Total height 1·5 to 2 mm. Sporangia cylindrical, stipitate, crowded, 1 to 1·5 mm. high, 0·6 mm. broad, copper-coloured, or deep brown with a carmine tinge; sporangium-wall irregularly evanescent above, the cup plaited and smooth below, papillose at the rim. Stalk cylindrical, 0·5 to 1 mm. long, red-brown or brownish-black, filled with spore-like cells, and rising from a membranous hypothallus. Capillitium an elastic network of freely branching red threads, 2·5 to 3·5 μ diam., marked with a border of broad-based spines or blunt cogs, and with three to four faint spiral bands, sometimes covered with minute spines in addition; with many free clavate ends and few attachments to the cup. Spores pale red, smooth, or with few scattered warts, 6 to 8 μ diam.—*Leangium stipatum* Schwein., in Trans. Am. Phil. Soc., New Ser. 4, p. 258 (1834). *Hemiarcyria stipata* Rost., Mon., App., p. 41; Macbride, in Bull. Nat. Hist. Iowa, p. 135.

Plate LXX., A.—*a*. sporangium with expanded capillitium, × 20; *b*. capillitium of upper part, × 600; *c*. capillitium of lower part, × 600; *d*. spore, × 600 (Ceylon); *e*. sporangia, × 20; *f*. capillitium of upper part, × 600; *g*. capillitium of lower part, × 600 (Iowa).

This species has been principally recorded from the United States, and is well described by Prof. Macbride; the faint spiral bands on the threads are either distinct or absent in different parts of the same capillitium, and their presence is not a sufficient character to remove the species from the genus *Arcyria*, with which it agrees in all other respects. Two gatherings of *A. stipata* have been obtained from India; one from Nepaul (K. 951), and one from Ceylon (B. M. 709). Both are marked *A. punicea*; the first is orange-red, the other bright scarlet; in both the capillitium forms a net of freely branching sinuous threads, with a border of closely-set blunt cogs; in some parts the thickenings consist of scattered spines, and towards the cup many of the threads are nearly smooth; throughout the network the characteristic spiral markings are more or less present, but indistinct in the specimen from Nepaul; there are many attachments to the cup, and numerous free ends.

Hab. On dead wood.—Ceylon (B. M. 709); Nepaul (K. 951); Mass. U.S. (L:B.M.159); Philadelphia (B. M. 950); Iowa (L:B.M.159).

8. **A. flava** Pers., in Römer, N. Mag. Bot., i., p. 90 (1794). Plasmodium watery-white, in rotten wood. Sporangia cylindrical, stipitate, clustered, 1·5 to 2 mm. high, 0·3 to 0·5 mm. broad; ochraceous-yellow or pale buff. Cup of sporangium-wall membranous, flaccid, reticulated and often spinulose on the inner side, interruptedly plicate. Stalk short, or elongated and weak, filled with spore-like cells, buff. Capillitium a very elastic network of pale yellow, terete or flattened threads, 3 to 4 μ diam., expanding into a drooping column 8 to 12 mm. in length, free from the cup, or with few attachments; thickenings on the threads in the form of sharp spines and half-rings arranged in a loose spiral, and of scattered spinules and short lines of broken reticulation; free ends more or less numerous, with clavate tips. Spores pale yellow, nearly smooth, marked with a few scattered warts, 6 to 8 μ diam.—*Trichia nutans* Bull., Champ., p. 122, t. 502, f. 3 (1791). *Arcyria nutans* Grev., Fl. Edin., p. 455 (1824); Rost., Mon., p. 277; Cooke, Myx. Brit., p. 72; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 11; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 125; Mass., Mon., p. 150.

Plate LXIX., A.—*a*. empty sporangia seated on a common hypothallus, with expanded capillitium, × 20; *b*. capillitium, with portion of the cup of the sporangium, and spore, × 600 (England).

Hab. On dead wood.—Lyme Regis, Dorset (L:B.M.160); Leytonstone, Essex (L:B.M.160); Kent (B. M. 1151); Camden Town, London (B. M. 1152); Batheaston, Somerset (B. M. 289); Leicester (B. M. 284); Boynton, Yorkshire (B. M. 1148); France (B. M. 970); Germany (B. M. 722); Poland (Strassb. Herb.); Iowa (L:B.M.160); S. Carolina (B. M. 969).

9. **A. Œrstedtii** Rost., Mon., p. 278 (1875). Plasmodium watery-white, in hard wood of fir, etc. Sporangia cylindrical,

curved, stipitate, clustered, rising from a common membranous hypothallus, 0·6 to 1·5 mm. high, 0·3 to 0·5 mm. broad, dull crimson; sporangium-wall evanescent above, with the exception of a few well defined rounded plates, which are papillose on the inner side, with a smooth margin; cup membranous, papillose with a smooth rim. Stalks varying in length, usually very short, weak, filled with spore-like cells, pale red. Capillitium a very elastic network of pale red, nearly terete threads, 3 to 5 μ diam., expanding into a drooping column three or four times the length of the sporangium; thickenings in the form of sharp spines 1 to 3 μ long, more or less equally distributed, though the spiral arrangement is generally shown; threads attached at numerous points to the persistent plates of the sporangium-wall, with few attachments to the cup; free ends sometimes present with spinulose tips. Spores pale red, nearly smooth, marked with few scattered warts, 7 to 8 μ diam.—Cooke, Myx. Brit., fig. 196; Lister, in Journ. Bot. (1891), p. 266; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 125; Mass., Mon., p. 147. *Hemiarcyria fuliginea* Cooke & Massee, in Grev., xvi., p. 74. *Arcyria fuliginea* Mass., Mon., p. 169. *Arcyria magna* Rex, in Proc. Acad. Nat. Sci. Phil. (1893), p. 364.

Plate LXIX., B.—*a*. sporangia and expanded capillitium, × 9; *b*. shield-like persistent portion of sporangium-wall, with capillitium attached, × 180; *c*. capillitium with portion of cup of sporangium-wall, and spore, × 600 (England).

A specimen in Strassb. Herb. marked "*Œrstedt*" is identical with the English gatherings of this species, as are also specimens from the United States received from Dr. Rex under the name of *A. Œrstedtii*. Although nearly allied to *A. flava*, it differs in the colour, and in the spines on the capillitium being more slender and closely set and more evenly distributed; it also differs in the presence of the well defined persistent portions of the sporangium-wall, which appears to be a very constant feature. Specimens received from different parts of the world possess the same characters with but little variation. The type specimen of *Hemiarcyria fuliginea* Cooke & Mass., from N. S. Wales (K. 154), has the capillitium attached to persistent papillose plates of the sporangium-wall, and is similar to the Lyme Regis gatherings of *A. Œrstedtii*, except in the colour, which is now fuliginous-brown. The constrictions and ovoid swellings in the capillitium, mentioned by Rostafinski as characteristic of this species, are sometimes met with in Lyme Regis gatherings; they frequently occur in *A. incarnata* and other *Arcyriæ*, and cannot be held to be of specific value.

Arcyria magna Rex, and *A. magna* var. *rosea* Rex, are represented by type specimens in the Museum (L:B.M.161); the expanded columns of capillitium are of the same form and dimensions as in *A. Œrstedtii*, taking for comparison five growths of that species which developed from white plasmodium during two successive years on a fir-log at Lyme Regis. The two forms named as above were gathered from one log of timber, and though var. *rosea* is brighter in colour than the other, they are evidently the same species: the sculpture on the threads of the capillitium does not differ from that of the Strassburg specimen referred to more widely than frequently appears in different

gatherings of any other species of *Arcyria*; the cup of the sporangium-wall is indeed smooth or nearly so, but the persistent plates which are conspicuous in the var. *rosea* are papillose and similar to those in the Lyme Regis and Strassburg specimens of *A. Œrstedtii* from which we are unable to detect a specific difference.

Hab. On dead wood.—Lyme Regis, Dorset (L:B.M.161); Sutton, Warwick (L:B.M.161); Germany (Strassb. Herb.); Denmark (K. 893); Norway (L:B.M.161); N. S. Wales (K. 154); Philadelphia (L:B.M.161).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

10. **A. affinis** Rost., Mon., p. 276 (1875). Sporangia cylindric-ovoid, 1 mm. high, stalks 1 mm. high, crowded on the substratum; mass of spores and capillitium purple-red, or yellowish-red; net of capillitium free from the cup, consisting of cylindrical threads 3·6 μ diam. in the lower part, 5·4 μ diam. in the upper part; thickenings as in *A. incarnata*.

Hab. On tree trunks.—Sweden.

This description applies to the bright-coloured forms of *A. incarnata*.

11. **A. similis** Racib., in Rozpr. Mat. Przyr. Ak. Krak., xii., p. 81 (1884). Sporangia shortly stipitate, cherry-coloured. Capillitium free from the cup, consisting of thick-walled, cylindrical or slightly compressed threads 4·2 to 5·8 μ diam., marked everywhere with warts and raised bands: bands usually half-ringshaped, arranged not in spirals as in *A. adnata*, but quite irregularly, or with a few placed one over the other as in *A. ferruginea*, or in broken, irregular spirals; spores 7·5 to 8·3 μ diam., almost colourless, thin-walled, distinctly verruculose.

Hab. Near Cracow, Poland.

This description suggests a form of *A. incarnata*, in which species the markings on the capillitium are subject to great variation in shape and arrangement.

12. **A. irregularis** Racib., *l.c.*, p. 83 (1884). Sporangia flesh-coloured, stipitate; stalks 0·5 mm. high, filled with colourless vesicles; cup hemispherical, the wall verruculose; capillitium forming an irregular network of flattened threads with undulate margins, 4·5 to 9·1 μ wide, 2·5 to 4·5 μ thick, densely beset throughout with irregular conical prominences, 0·8 to 1·5 μ broad, and usually elongated; spores 7 to 7·5 μ diam., with a firm, almost colourless wall.

Hab. On dead chestnut.—Near Cracow, Poland.

This description suggests also a form of *A. incarnata*.

13. **A. inermis** Racib., *l.c.*, p. 82 (1884). Sporangia stalked, brick-red; the stalk filled with vesicles and capillitium threads; net of capillitium consisting of cylindrico-complanate threads, 4·2 to 10·8 μ wide, marked with thickenings forming a reticulation with meshes 1·6 to 2 μ long, and almost equally broad. Spores 9·9 to 10·8 μ diam., the wall firm, reddish, distinctly warted.

Hab. On rotten wood.—Near Cracow, Poland.

This description applies to *A. ferruginea*.

14. **A. Raciborskii** Berl., in Sacc. Syll., vii., p. 430. Sporangia stipitate, stalks filled with vesicles; cup hemispherical, the wall thin, reddish, densely and minutely warted on the inner side; capillitium forming a loose net, with globose swellings at the nodes and also in the internodes; threads in the lower part flattened, with one margin dentate, elsewhere smooth; threads in the upper part subcylindrical, with the teeth arranged in a spiral, the remainder of the thread marked with undulating ridges, forming one to four spirals; becoming in some parts indistinct, or branching to form an irregular reticulation; spores minutely warted, 10·5 to 11·6 μ diam.—*A. decipiens* Rac., *l.c.*, p. 84 (non Berk.).

Hab. Near Cracow, Poland.

This description applies well to some forms of *A. ferruginea*.

15. **A. bonariensis** Speg., Ann. Soc. Cient. Argent., x., p. 151 (1880). Sporangia minute, 0·5 to 0·75 mm. high, 0·25 to 0·3 mm. broad, densely crowded in groups of 5 to 20, citron-yellow; the stalks half the height of the sporangium, concolorous; capillitium threads arising from the tube of the stalk, cylindrical, 3 μ diam., densely muricate, clear yellow-green; spores globose, granular, 10 μ diam.

Hab. On an old beam, Bonaria, Argentina. Allied to *A. nutans*, but quite distinct.

16. **A. cinnamomea** Hazslinszky, in Oester. Bot. Zeitschr., xxvii., p. 84 (1877). Sporangia cinnamon-red, gregarious, at length scattered, cylindrical; stalks of equal length, transparent, colourless; capillitium threads forming a network with hexagonal meshes, 3 to 4 μ diam., beset with small, shortly cylindrical warts; spores cinnamon-red.

Hab. On willow, Hungary.

This description applies to *A. ferruginea*.

17. **A. aurantiaca** Raunk., in Bot. Tidssk. (1888), p. 61, tab. 3, figs. 4, 9, 10, 11. Sporangia gregarious, ovate or shortly cylindrical, stipitate; stalk the same length as the sporangium, or shorter; thickenings on the inner side of the receptacle in the form of fine warts; wall, capillitium and spore mass orange- or brick-red; tubes of the capillitium with irregularly connected close-standing ring-like thickenings, 5 to 7 μ broad; spores smooth, 10 to 11 μ diam.

Hab. On rotten wood.—Denmark.

The above description and figures clearly refer to *A. ferruginea*.

18. **A. cornuvioides** Racib., in Hedw., xxviii., p. 123 (1889). Sporangia bright cinnamon, obovate on short stalks ¼ mm. high, or almost sessile and globose, 0·5 mm. diam., frequently confluent into irregular sessile plasmodiocarps, 3 mm. long, ½ mm. high; wall persistent in the lower part in the stalked forms as a flat cup marked with beautiful net-like thickenings on the inner side; capillitium threads 3 to 8 μ diam., much branched and anastomosing with few free ends, with band-like thickenings, either united to form a net, or scalariform, section of threads triangular or flattened; band-like thickenings not so regular as in *A. ferruginea*, much higher, often curved and suddenly disappearing; spores cinnamon in mass, smooth, 6·5 to 8·5 μ diam. The markings of the capillitium show near approach to *A. ferruginea* and *A. inermis*, and one might unite all three into a collective species: *A. ferruginea* has smooth spores 11 to 12 μ, *A. inermis* Rac. has the spores 10 to 12 μ, minutely warted.

Hab. On old trunks.—Poland.

SPECIES EXCLUDED FROM THE GENUS.

A. Bucknalli Mass.	=	*Trichia scabra* Rost.
A. chrysospora Mass.	=	*Hemitrichia chrysospora* List.
A. clavata Mass.	=	*Hemitrichia clavata* Rost.
A. decipiens Berk.	=	*Hemitrichia clavata* Rost.
A. Hariotii Mass.	=	*Lachnobolus circinans* Rost.
A. Karstenii Mass.	=	*Hemitrichia Karstenii* List.
A. leiocarpa Mass.	=	*Hemitrichia leiocarpa* List.
A. paradoxa Mass.	=	*Hemitrichia Karstenii* List.
A. rubiformis Mass.	=	*Hemitrichia rubiformis* List.
A. Serpula Mass.	=	*Hemitrichia Serpula* Rost.
A. stipitata Mass.	=	*Hemitrichia clavata* Rost.
A. Wigandii Mass.	=	*Hemitrichia Wigandii* List.

Genus 38.—**LACHNOBOLUS** Fries, Fl. Scan., p. 356 (1835). Sporangia sessile, clustered; sporangium-wall single, persistent, not thickened with angular granules; capillitium a loose network of cylindrical threads, with thickenings in the form of closely set warts.

1. **Lachnobolus circinans** Fries, Summa Veg. Scand., ii. (1849). Plasmodium? Sporangia subglobose, sessile, clustered, 0·5 to 0·8 mm. diam., ochraceous-brown, shining; sporangium-wall membranous, firm, papillose, ochraceous-yellow. Capillitium a network of freely branching, ochraceous-yellow threads, 2 to 5 μ diam., closely and equally beset with prominent warts; attached at numerous points to the sporangium-wall. Spores pale yellow, almost smooth, with a few scattered warts, 6 to 8 μ diam.—Rost., Mon., p. 282, fig. 186. *Arcyria circinans* Fr., Stirp. Femsj., p. 83 (1827). *Licea incarnata* Alb. & Schw., Consp. Fung., p. 109 (1805). *Lachnobolus incarnatus* Schroet., Krypt. Fl. Schles., p. 110 (1885); Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12;

Mass., Mon., p. 138. *Physarum congestum* Somm., Fl. Lap., p. 241 (1825). *Lachnobolus congesta* Berk. & Br., in Ann. Mag. Nat. Hist., Ser. 4, xvii., p. 140; Cooke, Myx. Brit., p. 74. *Arcyria Hariotii* Mass., Mon., p. 155. *Lachnobolus Sauteri* Rost., in Fuckel, Symb. Myc. Nachtr., p. 76.

Plate LXX., B.—*a*. sporangia, × 20; *b*. capillitium with portion of sporangium-wall and spores, × 600 (England).

The type specimen of *Arcyria Hariotii* Mass., in Paris Herb., is typical *L. circinans*.

Hab. On dead wood.—Haypit, Stafford (L:B.M.162); Somerset (B. M. 291); France (Paris Herb.); Tyrol (Strassb. Herb.); Iowa (B. M. 1027, 1028).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

2. **L. Arcyrella** Rost., Mon., p. 431 (1875). Sporangia pyriform, fulvous or almost straw-coloured; stalk about as long as the sporangium, yellowish; capillitium not elastically expanding, forming a lax irregular network, threads 2·5 to 8·3 μ diam., attached at many points to the sporangium-wall, some threads descending into the tube of the stem, marked with numerous small obtuse warts; spores smooth, 7 to 8 μ diam.

Hab. Jutland.

This description applies to *Arcyria albida*.

3. **L. Rostafinskii** Racib., in Rozpr. Mat.-Przyr. Ak. Krak., xii., p. 80 (1884). Sporangia stipitate, ovoid-conical, apex rounded, yellowish-grey, the lower part of the sporangium with a distinct membrane, hemispherico-patelliform, the upper part destitute of a membrane; capillitium well developed, forming a net adnate to the sporangium-wall by numerous attachments, the upper part with many free rounded ends; threads 4·2 to 8·2 μ diam., marked with slender ridge-like processes forming a reticulation; spores smooth, yellowish, almost colourless, 7·5 to 8·3 μ diam.

Hab. On dead birch roots.—Near Cracow, Poland.

This description suggests a form of *Arcyria flava* Pers., in which developments sometimes occur closely corresponding with the above account.

SPECIES EXCLUDED FROM THE GENUS.

L. globosus Rost. = *Arcyria albida* Pers.

Genus 39.—**PERICHÆNA** Fries, Symb. Gaster., p. 11 (1817). Sporangia sessile, subglobose or plasmodiocarps; sporangium-wall of two layers, the outer thickened with dark angular granules, which are exceptionally absent in the upper part, the inner membranous; capillitium of branching or simple threads, spinose, minutely warted, or nearly smooth, marked with irregular constrictions; spores yellow, minutely warted.

KEY TO THE SPECIES OF *PERICHÆNA*.

A. Sporangium-wall stout, brown, black or grey, inner layer smooth.

Capillitium spinose, abundant. 1. *P. chrysosperma*

Capillitium minutely warted, abundant; spores 10 to 11 μ diam. 2. *P. depressa*

Capillitium minutely warted or nearly smooth, scanty; spores 12 to 14 μ diam. 3. *P. populina*

B. Sporangium-wall yellow or pale umber, inner layer papillose. 4. *P. variabilis*

1. **P. chrysosperma** Lister. Plasmodium pale brown, in rotten bark. Sporangia subglobose, sessile, or shortly stalked, often forming horse-shoe or ring-shaped plasmodiocarps, scattered, 0·4 to 1 mm. diam., chestnut or red-brown, dehiscing irregularly; sporangium-wall of two layers, the outer composed of brown granular matter, which either forms a complete crust, or is more or less obsolete; the inner layer subcartilaginous, yellowish-olive, translucent. Stalk, when present, stout, black. Capillitium abundant, forming a loose network of sparingly branched yellow threads 2 to 4 μ diam., irregularly constricted, spinose, spines 1 to 6 μ long, subulate, curved, scattered. Spores citron-yellow in mass, minutely warted, 9 to 10 μ diam., rarely 7 to 8 μ.—*Ophiotheca chrysosperma* Currey, in Quart. Micr. Journ., ii., p. 240 (1854). *Trichia circumscissa* Wallr., Fl. Cryp. Ger., p. 378 (1833). *Cornuvia circumscissa* Rost., Mon., p. 290; Cooke, Myx. Brit., p. 76. *Ophiotheca circumscissa* Mass., Mon., p. 131. *Ophiotheca Wrightii* Berk. & Curt., in Journ Linn. Soc., x., p. 349; Mass., Mon., p. 132. *Cornuvia Wrightii* Rost., Mon., App., p. 36; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 122.

Plate LXXI., A.—*a*. sporangia, stalked and sessile, × 20; *b*. capillitium from different sporangia growing on the same piece of walnut bark, and spore, × 600 (England).

It would appear that Rostafinski excluded this species, which he named *Cornuvia circumscissa*, from the genus *Perichæna*, because he defined that genus as having capillitium without characteristic thickenings; but in *P. populina*, to which this definition most nearly applies, the capillitium is usually closely warted and notched, rarely smooth, while in some gatherings the threads are beset with scattered sharp spines in addition to crowded spinules. In *P. depressa* and *P. vermicularis* the capillitium is never smooth, though the thickenings may be reduced to minute warts; the character given by Rostafinski is therefore inapplicable, and in every feature except the large development of spines on the threads, *P. chrysosperma* is closely allied to the other members of the group. In a gathering of this species at Lyme Regis, two of the sporangia examined have smooth threads with a few minute spines distantly scattered, in others the spines are of the usual form, loosely set, and about 2·5 μ long; but in the greater number of sporangia the spines measure 5 to 6·5 μ in length. The characters

of this gathering embrace the varieties given as "*a. scabra*" and "*β. spinosa*" by Schrœter, and also those of the numerous specimens of *Cornuvia Wrightii* Rost., from the United States, including the type from Cuba gathered by Wright. A specimen from Mr. Morgan, from Ohio, stands alone in having small spores 7 to 8 μ diam.; in other respects it is typical.

The circumscissile form of the sporangia is not met with in any of the collections, or in my own gatherings. From the original account of *Trichia circumscissa* by Wallroth, it is possible that the specimen described by him was *Perichæna depressa*; the specific name given by Currey is therefore here adopted.

Hab. On dead bark.—Lyme Regis, Dorset (L:B.M.163); Herb. Broome (B. M. 308); Ceylon (K. 1712); Philadelphia (L:B.M.163); Ohio (L:B.M.163); Iowa (L:B.M.163); Cuba (B. M. 699).

2. **P. depressa** Libert, Pl. Crypt. Ard. Fasc., iv., No. 378 (1837). Plasmodium? Sporangia sessile, crowded, polygonal from mutual pressure, depressed, 0·5 to 1 mm. diam., purple- or red-brown, dehiscing along the margin with a well-defined lid; sporangium-wall of two layers, the outer cartilaginous charged with brown granular matter, more or less closely combined with the membranous, smooth, inner layer. Capillitium an abundant web of branched, slender, yellow threads, 1·5 to 2·5 μ diam., minutely warted and marked with irregular constrictions. Spores golden-yellow, minutely warted, 8 to 12 μ diam.—Rost., Mon., p. 292; Cooke, Myx. Brit., p. 77; Mass., Mon., p. 114. *Perichæna artocreas* Berk. & Rav., in Grev., ii., p. 68. *Perichæna irregularis* Berk. & Curt., in Grev., ii., p. 68. *Ophiotheca irregularis* Mass., Mon., p. 132. *Stegasma australe* Cesati in Rabenh., Fungi Eur., No. 1865 (1874). *Perichæna australis* Berl., in Sacc. Syll., vii., p. 422; Mass., Mon., p. 119. *Perichæna applanata* Mass., Mon., p. 116.

Plate LXXI., B.—*a.* sporangia, × 20; *b.* capillitium, × 280; *c.* capillitium and spore, × 600 (England).

The type specimen of *P. applanata* Mass., from Brisbane (K. 153), is characterised by the outer layer of the sporangium-wall having a superficial crust of angular crystals of lime, which gives the sporangia a lilac-grey colour; in all other respects, in the abundant and minutely warted capillitium, and in the spores measuring 10 to 12 μ diam., it agrees with *P. depressa*. Deposits of lime on the sporangium-wall are of frequent occurrence both in the latter species and in *P. populina*, and although they are unusually abundant in the Brisbane specimen, the character is not of sufficient importance to give specific distinction. The type specimen of *P. artocreas* Berk. & Rav. from S. Carolina (K. 1027 and B. M. 697) appears to be *P. depressa* with abundant capillitium, and spores measuring 8 to 10 μ; the sporangia are polygonal, depressed, pale brown; the inner layer of the sporangium-wall is smooth, and not papillose as in *P. variabilis*. The type specimen of *P. irregularis* Berk. & Curt. from S. Carolina (K. 1706) is typical *P. depressa*. A type specimen of *Stegasma australe* Ces. (B. M. 1034), is in imperfect condition, but it appears to be *P. depressa* from the many broken pieces of minutely warted capillitium, and the spores, which measure 10 to 11 μ diam.

Hab. On dead wood and bark.—Epping Forest, Essex (L:B.M.164); Lyme Regis, Dorset (L:B.M.164); Leicestershire (B. M. 696); Glamis, Scotland (B. M. 323); Belgium (B. M. 690); Germany (B. M. 688); Italy (B. M. 689); Poland (Strassb. Herb.); Australia (K. 153); Philadelphia (L:B.M.164); Ohio (L:B.M.164); S. Carolina (B. M. 697, 986).

3. **P. populina** Fries, Symb. Gaster., p. 12 (1817). Plasmodium watery-grey, in decaying bark. Sporangia globose, depressed, ellipsoid, or forming short broad plasmodiocarps, crowded, sessile on a broad or narrow base, rarely substipitate, 0·5 to 1 mm. diam., dark purple or purplish-brown, nut-brown, grey or white, dehiscing along definite lines, either horizontally with a convex lid or in broad sinuous lobes; sporangium-wall of two layers, the outer cartilaginous, opaque, charged with brown granular matter intermixed with acicular or angular calcareous deposits which form a pruinose or crystalline covering in the grey and white sporangia; inner layer membranous, usually closely combined with the outer. Capillitium scanty or almost wanting, consisting of slender, branched or simple, yellow threads, 1·5 to 4 μ diam., irregularly compressed, angled and constricted, minutely warted, rarely smooth; attached to the sporangium-wall or free. Spores yellow, more or less minutely warted, 12 to 14 μ diam.—*Lycoperdon corticale* Batsch, Elench. Fung., p. 155 (1783). *Perichæna corticalis* Rost., Mon., p. 293, fig. 188; Cooke, Myx. Brit., p. 78; Zopf, in Schenk, Handbuch der Botanik, iii., 2, p. 169; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 10; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 120; Mass., Mon., p. 115. *Trichia fusco-atra* Sibth., Fl. Oxon, p. 407 (1794). *Perichæna fusco-atra* Rost., Mon., p. 294; Cooke, Myx. Brit., p. 78. *Licea pannorum* Cienk. (non Wallr.), Pringsh., Jahrb., iii., p. 407. *Perichæna liceoides* Rost., Mon., p. 295; Mass., Mon., p. 118. *Oligonema Broomei* Mass., in Journ. R. Micr. Soc. (1889), p. 346; Mass., Mon., p. 172.

Plate LXXII., A.—*a.* sporangia, × 20; *b.* capillitium and portion of sporangium-wall, × 280; *c.* capillitium and spore, × 600 (England).

In large developments from one plasmodium on the inner side of the bark of old stumps, every variety of form is sometimes represented, from broad plasmodiocarps to globose and substipitate sporangia, and the colour may range from deep purple to grey. In gatherings where the colour is pure white, the outer layer of the sporangium-wall consists of crystalline deposits of lime without the intermixture of brown granules. The capillitium is subject to much variation according to the season of the year and other causes. In a gathering at Lyme Regis in the autumn, the capillitium was scanty, forming a net of rugged coarsely warted threads 2 to 4 μ diam., with a few scattered free threads; in the following spring another growth on the same pieces of bark had sporangia of a similar shape and colour, but with a more abundant capillitium forming a freely branching slender network of minutely warted threads 1 to 1·5 μ diam., scarcely differing from that of *P. depressa*, the larger spores being the chief character which distinguished the gathering from that species. The specimens

of *P. fusco-atra* in the collections differ in no respect from forms of *P. populina*, and cannot be held as specifically distinct. The type specimen of *Oligonema Broomei* Mass. from Warleigh (B. M. 364) is typical *P. populina* with characteristic branching capillitium threads marked with irregular swellings and spinules, and with minutely and closely warted spores 14 to 15 μ diam. The specimen described by Cienkowski as *Licea pannorum*, l.c., is given by Rostafinski as the type of a new species, *Perichæna liceoides*, characterised by the scanty capillitium of free threads and the spores measuring 9 to 10 μ; Zopf, on the other hand, quotes it as a synonym for *P. populina*; and this view is confirmed by the not infrequent occurrence of forms of the latter species with scanty or no capillitium, and spores measuring from 10 to 12 μ.

Hab. On dead wood and bark.—Batheaston, Somerset (B. M. 309, 320); Shrewsbury (B. M. 322); Lyme Regis, Dorset (L:B.M.165); Salisbury (L:B.M.165); Brentwood, Essex (L:B.M.165); Boynton, Yorkshire (B.M. 1160); Tregayan, Anglesey (B.M.); France (B.M. 1161); Germany (B. M. 653); Finland (B. M. 767); Sweden (K. 1702); Tasmania (K. 1710); Philadelphia (L:B.M.165); Ohio (L:B.M.165); Florida (B. M. 987).

4. **P. variabilis** Rost., Mon., p. 295 (1875). Plasmodium? Sporangia sessile, globose on a narrow base, 0·5 mm. diam., or forming curved or net-like plasmodiocarps, scattered, ochraceous-yellow or pale umber; sporangium-wall of two layers, the outer charged with dark angular granules, closely combined with the membranous papillose inner layer; in some cases the outer layer is not distinguishable in the upper part of the sporangium. Capillitium a profuse network of sparingly branched, yellow threads, 2 to 4 μ diam., rough with minute scattered warts and irregular constrictions. Spores yellow, minutely warted, 10 to 15 μ diam.—*Physarum vermiculare* Schwein., in Trans. Am. Phil. Soc., N. Ser., iv., p. 257 (1834). *Ophiotheca vermicularis* Mass., Mon., p. 134. *Perichæna vermicularis* Rost., Mon., App., p. 34 (1876); Lister, in Jour. Bot. (1891), p. 265. *Perichæna Friesiana* Rost., Mon., p. 296. *Ophiotheca umbrina* Berk. & Curt., in Grev., ii., p. 68. *Licea reticulata* Berk. & Br., in Journ. Linn. Soc., xiv., p. 86. *Perichæna reticulata* Rost., Mon., App., p. 35. *Ophiotheca reticulata* Mass., Mon., p. 133. *Perichæna confusa* Mass., Mon., p. 117.

Plate LXXII., B.—*a*. sporangia, × 20; *b*. portion of papillose wall of the upper part of the sporangium, × 280; *c*. capillitium and spores, × 280; *d*. capillitium and spore, × 600 (England).

The yellow form of this species has appeared in some abundance in successive years at Lyme Regis, and corresponds exactly with the type specimen of *Physarum vermiculare* from Schweinitz (K. 1671). The German type of *P. variabilis* is not represented in the Strassburg or British collections, but examination of the type of *Ophiotheca umbrina* from Curtis (K. 1705), which is given as a synonym for *P. variabilis* by Rostafinski (Mon., App., p. 35) shows that it is a pale umber, plasmodiocarp form, agreeing in the structure of the sporangium-wall, capillitium, and spores with the English gatherings. *P. Friesiana* Rost. is described as differing from *P. variabilis* in the

former having a double and the latter a single sporangium-wall; but this character is inconstant, as mentioned in the text. The specimen from Ellis, No. 726, N. Am. Fungi (K. 990), originally named *P. Friesiana*, and then *O. umbrina*, resembles the Lyme Regis gatherings and Rostafinski's description of his German types of *P. variabilis*. The specimen from Ellis and that from Lyme Regis (K. 991) are given as the types of a new species, *P. confusa* Mass.; but surely on insufficient grounds. The type of *Licea reticulata* Berk. & Br., from Ceylon (L:B.M.166) is also *P. variabilis*; the sporangia consist of minute pale umber, net-like plasmodiocarps, some of which have very scanty capillitium, but in others it is more abundant and of the usual minutely warted type; the spores are closely and minutely warted and measure 11 to 15 μ. In all the specimens enumerated above, the inner layer of the sporangium-wall is minutely papillose, a character by which this species of *Perichæna* is distinguished from all others.

Hab. On dead leaves, wood, etc.—Lyme Regis, Dorset (L:B.M.166); Batheaston (B. M. 310, 311); Luton, Beds (L:B.M.166); Ceylon (L:B.M.166); New Jersey (K. 990); Philadelphia (L:B.M.166); N. Carolina (K. 1671, 1705); S. Carolina (B. M. 953).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

5. **Perichæna Rostafinskii** Karst., in Bidr. Känn. Finl. Nat. (1879), p. 130. Sporangia scattered and subgregarious, sessile, globose, yellowish-brown, shining. Capillitium wanting. Spores globose, almost smooth, dark or blackish brown, brownish under the microscope, 10 to 27 μ diam.

Hab. On moss and dead leaves.—Finland.

This description suggests an imperfect development of *P. populina*.

6. **P. microcarpa** Schroet., Krypt. Fl. Schles., p. 108 (1885). Sporangia solitary or in small groups, subglobose, 0·5 mm. diam., more rarely irregular, depressed, yellowish-brown, smooth, opaque, dehiscing irregularly; capillitium abundant, forming a regular lax net of yellow threads, 1·5 to 2 μ diam., somewhat wider at the angles. Spores golden-yellow, strongly spinose, 15 to 17 μ diam.

Hab. On dead leaves.—Breslau, Silesia.

7. **P. pallida** Berl., in Sacc., Syll., vii., p. 422. Sporangia gregarious, pale tan-coloured; spores yellow, but paler than in *P. australis*.—*Stegasma pallida* Cesati, Atti Accad. Sc. Fis. Mat., viii., p. 12 (1879).

Hab. Sarawak, Borneo.

This description is too brief to be of use.

8. **P. canoflavescens** Raunk., in Bot. Tidssk. (1888), p. 54. Sporangia clustered on a thin yellow-grey hypothallus, globose, hemispherical or reniform, sessile, 0·5 mm. diam., bright yellow-grey, dehiscing more or less regularly with a lid; the wall

thickly encrusted with numerous round, angular, or rod-shaped bodies, only very partially consisting of lime, the upper part marked on the inside with delicate bands forming a regular reticulation with 5 to 6 angled meshes, 12 μ diam. Capillitium scarcely evident, consisting of few weak, simple, or branched yellowish threads 1·5 to 2 μ diam., unequally warted. Spores golden-yellow, delicately warted, 12 to 14 μ diam.

Hab. On beech bark.—Denmark.

This description applies perfectly to forms of *P. populina* with scanty capillitium.

9. **P. nitens** Raunk., *l.c.*, p. 55. Sporangia solitary or clustered, globose-pyriform, sessile or shortly stipitate, dehiscing irregularly, greyish-brown with a violet metallic lustre, 0·5 mm. diam.; wall single, almost without deposits of granules. Capillitium of long weak threads, slightly branched, attached to the sporangium-wall by irregular enlargements, unequally and delicately spinulose, of equal breadth throughout, 1 to 1·5 μ diam. Spores delicately spinulose, yellowish, 10 to 12 μ diam.

This description suggests a small-spored form of *P. populina*.

10. **P. Krupii** Racib., in Hedw., xxviii., p. 124 (1889). Sporangia chestnut-brown, rarely globose, depressed, solitary, usually flat creeping plasmodiocarps, irregularly ring-shaped or vermiform, 0·5 to 1·2 mm. long, plasmodiocarps as much as 15 mm. in length, 0·5 to 0·75 mm. high; sporangium-wall simple, iridescent, chestnut-brown, finely warted, breaking away as a lid in the upper part. Capillitium forming a dense web of rather thick-walled threads, 0·3 to 1·5 μ diam., covered with crowded irregularly shaped, wart-like thickenings giving a toothed appearance, without constrictions, rarely branching; capillitium connected with the sporangium-wall by many thin smooth connecting threads. Besides these there are small, short or long outgrowths from the sporangium-wall 2 to 12 μ long, 1 to 3 μ thick, 200 to 500 on a square millimetre of the wall. Spores globose, brownish-yellow, minutely warted, 7 to 8·5 μ diam.

Hab. On bark.—Tatra Mounts, Poland.

This description suggests a species of *Dianema*, possibly *D. corticatum*.

11. **P. ?pseudæcidium** Speg., in Ann. Soc. Cient. Argent., xxii., p. 187 (1886). Sporangia cylindrical, conical, or calyciform, 1 to 1·5 mm. long, 0·5 to 1 mm. broad, sessile or shortly stipitate, wall very thin cartilagino-membranaceous, base even or minutely rugulose, dehiscing at the apex in an irregularly laciniate or fimbriate manner, chestnut or brownish; mass of spores and capillitium citron or yellowish; capillitium threads very slender, 1 μ thick, sparingly branched here and there with solitary conical or elongated branch-like spines, yellowish; hyaline. Spores

globose, 6 to 7 μ diam., often irregularly angled from mutual pressure, smooth, pale vinous with a yellow tinge.

Hab. On living fronds of many species of fern and on *Tillandsia muscoides*.—Argentine Republic. A beautiful but paradoxical species, exactly resembling a folicolous *Æcidium*; it will probably form the type of a new genus.

From the description of the fimbriate sporangium-wall, mycelium-like capillitium threads and angular spores, it is possible that this species does not belong to the *Mycetozoa*.

EXCLUDED FROM THE MYCETOZOA.

P. strobilina Fr., *P. decipiens* Berk. & Br., and *P. picea* Berk. & Br.

Order III.—MARGARITACEÆ. Sporangia normally sessile, sporangium-wall single, smooth, translucent; capillitium abundant, not consisting of separate elaters nor combined into a net; spores pinkish or yellowish-grey.

KEY TO THE GENERA OF *MARGARITACEÆ*.

Capillitium profuse, long, coiled, hair-like, 0·5 to 2 μ thick.
(40) MARGARITA.

Fig. 48.—*Margarita metallica* Lister.
a. Two sporangia. Magnified 6 times.
b. Part of a long capillitium thread, and a spore. Magnified 250 times.

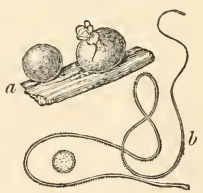

Fig. 48.

Capillitium of nearly straight threads, without spiral thickenings, attached at both ends to the sporangium-wall.
(41) DIANEMA.

Fig. 49.—*Dianema depressum* Lister.
a. Plasmodiocarp. Magnified twice.
b. Capillitium attached above and below to the walls of the sporangium. Magnified 50 times.
c. Spore. Magnified 560 times.

Fig. 49.

Capillitium of fasciculate threads, penicillate and slender above, marked with spiral thickenings, attached above and below to the sporangium-wall. (42) PROTOTRICHIA.

Fig. 50.

Fig. 50.—*Prototrichia flagellifera* Rost.
a. Group of sporangia. Magnified 4 times.
b. Capillitium attached above to a fragment of the sporangium-wall, and a spore. Magnified 280 times.

Genus 40.—**MARGARITA** Lister, gen. nov. Sporangia globose; capillitium a profuse web of coiled hair-like, sparingly-branched, slender, solid threads, with indistinct attachments to the sporangium-wall.

1. **M. metallica** Lister. Plasmodium watery-white, among dead leaves and rotten wood. Sporangia globose, sessile on a narrow base, 0·5 to 1 mm. diam., solitary or gregarious, pearl-grey or copper-coloured, shining, iridescent; sporangium-wall single, somewhat tough, glaucous or yellowish, translucent. Capillitium a profuse web of very long, even, solid, grey or yellowish threads, 0·5 to 1 μ diam., increasing in some parts to 2 μ, scarcely branching, with few attachments to the sporangium-wall or apparently free. Spores pale yellow or nearly colourless, minutely warted, 10 to 11 μ diam.—*Physarum metallicum* Berk. & Br., in Mag. Zool. and Bot., i., p. 49 (1838). *Cornuvia metallica* Rost., Mon., App., p. 35; Cooke, Myx. Brit., p. 76. *Perichæna plasmodiocarpa* Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 10.

Plate LXXIII., A.—*a*. sporangia, × 20; *b*. capillitium, showing the bulbous end of a delicate thread adhering to a portion of the sporangium-wall, and spores, × 280; *c*. capillitium and spore, × 600 (England).

The capillitium is usually papillose on one side of the waved thread. The spores vary in roughness from being distinctly warted to nearly smooth. In gatherings from Lyme Regis, Dorset, and Wanstead, Essex, the sporangia are scattered or crowded, pearly grey or iridescent bronze; those in Broome's collection, British Museum, are more or less coppery. In specimens submitted by Prof. Blytt, of Christiania, they are subglobose, and crowded with broad bases on a common hypothallus; the colour is bright copper, resembling some of Broome's specimens; the capillitium and spores are similar to those in the English gatherings. This species has been removed from the genus *Cornuvia* on account of the remote connection it holds with *C. Serpula*, which at present may be considered the sole representative of that genus. The name *Margarita* is given to the genus on account of the pearl-like appearance of the sporangia.

Hab. On dead leaves, sticks, etc.—Batheaston, Somerset (B. M. 94, 95, 98, 272); Wanstead, Essex (L:B.M.167); Lyme Regis, Dorset (L:B.M.167); Birmingham (L:B.M.167); Norway (L:B.M.167).

Genus 41.—**DIANEMA** Rex, in Proc. Acad. Nat. Sc. Phil., p. 397 (1891). Sporangia simple, often forming plasmodiocarps, depressed, sporangium-wall membranous, without lime; capillitium abundant, of nearly straight threads without spiral thickenings, attached at both ends to the sporangium-wall.

KEY TO THE SPECIES OF *DIANEMA*.

Sporangium-wall translucent, spores free—
Spores minutely warted. 1. *D. Harveyi*
Spores reticulated. 2. *D. depressum*
Sporangium-wall granular, spores clustered, minutely warted 3. *D. corticatum*

1. **D. Harveyi** Rex, *l.c.* Plasmodium? Sporangia sessile, rounded or cushion-shaped, flattened above, averaging 1 mm. in diam., 0·35 mm. in height, sometimes elongated and bent into an irregular horse-shoe shape, dull red or gold-bronze, with a metallic lustre; sporangium-wall membranous, thin, translucent, beset with the persistent ends of the capillitium when the rest of the threads have broken away. Capillitium of numerous slender, brownish-yellow threads, 1·5 to 2 μ diam., not connected with each other, simple or sparingly branched, forked two or three times near their origin or insertion, nearly parallel, straight or flexuose, running from the base to the upper wall of the sporangium. Spores pale yellow, minutely warted 8 to 10 μ diam.

Plate LXXIV., A.—*a*. sporangia, × 20; *b*. capillitium, showing attachment of the threads to the base and upper wall of the sporangium, and spores, × 280; *c*. spores, × 600 (England).

The specimen figured is taken from a gathering of eighteen sporangia on an ash stick near Lyme Regis, in the spring of 1894. They agree with the type from America in capillitium and spores, but the colour of the sporangia is dull brick-red. By the light of these specimens, that in Broome's Collection (B. M. 94) marked *Physarum metallicum*, is clearly the same species; it is in a fragile condition, and as the capillitium breaks up when mounted, the characters are difficult to recognise; but the numerous broken points of attachment to the base and upper wall of the sporangium, together with the minutely warted spores, leave no doubt of its identity. The date and locality are not given by Broome, but it is probable that it was gathered at Batheaston in 1869 or 1870, as it stands in his collection among other specimens correctly marked *Physarum metallicum* gathered there at that date.

Hab. On dead wood.—Lyme Regis, Dorset (L:B.M.168); Maine (L:B.M.168 *slide*).

2. **D. depressum** Lister. Plasmodium white, rarely rosy red, in rotten apple logs, ash sticks, etc. Sporangia forming sessile, pulvinate, depressed, broad plasmodiocarps, 2 to 10 mm. wide, about 0·3 mm. thick, when immature shining violet, ripening to grey-brown; sporangium-wall a smooth, translucent, yellowish-grey membrane, beset with the persistent ends of the capillitium when the rest of the threads have fallen away. Capillitium

profuse, consisting of pale yellowish-grey, straight, rigid, slender threads, 0·5 to 2 μ thick, forking at an acute angle, connected with each other at the opposite ends, or fasciculate, without free branches, minutely papillose on one side, attached above and below to the sporangium-wall by the suddenly acuminate extremities. Spores pale yellowish-grey, closely reticulated over the greater part of the surface with raised bands, forming a border 0·5 to 1 μ broad, the remaining part marked with broken or very loose reticulation, 6 to 8 μ diam.—*Cornuvia depressa* List., in Journ. Bot. (1891), p. 265.

Plate LXXIV., B.—*a*. sporangium, × 20 ; *b*. capillitium, showing attachment of the threads to the base and upper wall of the sporangium, and spores, × 280 ; *c*. capillitium and spores, × 600 (England).

A description of this species was given in Journ. of Botany, *l.c.*, under the name of *Cornuvia depressa*, on account of its affinity with *Margarita metallica*, which at that time was included in the genus *Cornuvia*. Dr. Rex having since established the genus *Dianema* for the closely allied American species, it is here adopted as in every way the more appropriate position for this species.

Hab. On dead wood.—Batheaston, Somerset (B. M. 2, 3, 4, 5, 96, 300) ; St. Catherines (B. M. 19*a*) ; Rudloe, Wilts (B. M. 19) ; Lyme Regis, Dorset (L:B.M.169).

3. D. corticatum Lister, sp. nov. Plasmodium pink. Sporangia hemispherical, 1 mm. diam., more often forming ring-shaped, elongated, or netlike plasmodiocarps 3 to 12 mm. long, shining or opaque, chestnut or lurid brown; sporangium-wall ochraceous-olive, composed of two layers, the outer densely granular, the inner hyaline. Capillitium somewhat sparse, consisting of simple or acutely branching, slender, brown and pale threads, 0·5—1·5 μ diam., often with distant beadlike thickenings, either nearly smooth or marked with a single prominent spiral band, occasionally for a short distance with three bands ; the threads are attached above and below by very delicate extremities to the sporangium-wall. Spores brownish-pink in mass, nearly colourless when highly magnified, subelliptical, adhering in clusters of 4 to 6, minutely warted on the outer side, 10 to 12 × 8 to 9 μ diam.

Plate LXXVII., B.—*a*. plasmodiocarp, × 20 ; *b*. capillitium attached to fragment of sporangium-wall, and clustered spores, × 280 ; *c*. capillitium, × 600 ; *d*. spores, × 600 (Norway).

This species was found in some abundance on rotten planks at Sande, Norway, September, 1894, in company with *Licea flexuosa*, to which it bears a strong resemblance under a pocket lens. It holds an intermediate position between the genera *Dianema* and *Prototrichia*, having the general features of the former, but exhibiting in some sporangia the spiral bands on the capillitium characteristic of the latter. It differs from the species hitherto comprised in both genera in the more substantial sporangium-wall and in the clustered spores. The description of *Perichæna Krupii* Racib. (see p. 201) may possibly refer to this species.

Hab. On rotten wood.—Norway (L:B.M. 174).

Genus 42.—**PROTOTRICHIA** Rostafinski, Mon., App., p. 38, 1876. Sporangia normally sessile, globose; capillitium of fasciculate threads, penicillate and slender above, marked with spiral thickenings, attached above and below to the sporangium-wall.

1. **P. flagellifera** Rost., Mon., App., p. 38 (1876). Plasmodium white, in larch and fir plantations. Sporangia subglobose, sessile on a broad base, rarely stalked, crowded, or scattered, 0·5 to 1 mm. diam., brown or pinkish-brown, shining or iridescent; sporangium-wall a substantial pale pinkish-brown or glaucous, smooth, translucent membrane, sprinkled on the inner side with the slender persistent ends of the broken capillitium threads. Stalk, when present, cylindrical, 0·1 to 0·4 mm. long, 0·05 mm. thick, solid, brown. Capillitium of numerous red- or olive-brown stout strands, rising from the base of the sporangium, marked with spiral thickenings, branching repeatedly above in a pencil of more slender threads attached at their extremities to the sporangium-wall. Spores pale pinkish-brown, minutely warted, 10 to 11 μ diam.—Cooke, Myx. Brit., p. 65; Mass., Mon., p. 127. *Trichia flagellifer* Berk. & Br., in Ann. Mag. Nat. Hist., Ser. 3, xviii., p. 56. *Trichia metallica* Berk., in Hooker's Bot. Antarct. Voyage, Part iii., vol. ii. (1860), p. 268. *Prototrichia metallica* Mass. in Journ. R. Micr. Soc. (1889), p. 350; Mass., Mon., p. 127. *Prototrichia elegantula* Rost., Mon., App., p. 39; Blytt, Bidr. K. Norg., Sop. iii. (1892), p. 12. *Prototrichia cuprea* Mass., in Jour. R. Micr. Soc. (1889), p. 351; Mass., Mon., p. 129. *Prototrichia chamæleontina* Mass., Mon., p. 130.

Plate LXXIII., B.—*a*. sporangia, × 20; *b*. part of a strand of capillitium, and spores, × 280; *c*. part of the base of a sporangium, showing the attachments of the strands of capillitium, × 280; *d*. capillitium and spore, × 600 (England).

P. flagellifera occurs abundantly in the neighbourhood of Lyme Regis, in a larch plantation, where it has been gathered for several years, in the autumn and winter, on dead brambles and sticks. It is a species that is subject to considerable variation from changes of temperature and weather. In the most perfect development the strands of the capillitium are deep red-brown, sharply marked with regular and close spiral bands, springing erect, but with intertwining branches as far as the upper third, where they divide into a brush of more slender straight threads, and the spores are pale pinkish-brown, distinctly warted. Where the development has been checked by cold or dry weather, the threads are pale olive, with irregular or lax branches and indistinct spiral markings; or the spiral character may be wanting, replaced by broad or narrow rings. Associated with this form the spores are paler and more yellow, and faintly warted or nearly smooth. In cultivations, when the plasmodium has been shaken in conveying it from the wood, the capillitium forms very irregularly, sometimes anastomosing with broad and flat expansions with no appearance of spirals. Similar specimens have been received from Mr. Camm, Smethwick, in spring gatherings after cold weather: this is the form described under the name of *Prototrichia chamæleontina* Mass.; it is entirely different from *Cornuvia metallica* Rost., which is given as a synonym by that author. The gathering from Badminton (K. 1740, B. M. 333),

referred to by Rostafinski as a type of *P. flagellifera*, is the form with olivaceous capillitium and nearly smooth spores. The type of *Trichia metallica* Berk., from Tasmania (K. 1741), is almost destroyed, but the spores and sporangium-wall indicate that it was of the Badminton form. The type of *P. elegantula* Rost., from Sweden (K. 1743), is a more perfect development with distinctly warted spores. *P. cuprea* Mass., from Scarborough and Carlisle (K. 1744, 1745), is a frequent form with minutely warted spores, and is similar to specimens of *P. flagellifera* in Broome's collection. The large gatherings from Lyme Regis, showing all degrees of variation, demonstrate that the specimens in the collections to which different names have been given represent one species, whose diverging forms are too inconstant to be defined even as varieties.

Hab. On dead sticks, bark, etc.—Batheaston, Somerset (B. M. 324 to 331); Badminton, Gloucester (B. M. 333); Lyme Regis, Dorset (L:B.M.170); Smethwick, Stafford (L:B.M.170); Berwick (Phillips' Coll.); Sweden (K. 1743); Norway (Christiania Herb.); Tasmania (K. 1741).

SPECIES EXCLUDED FROM THE GENUS.

P. Bombarda Mass. = *Alwisia Bombarda* Berk. & Br.

Order IV.—LYCOGALACEÆ. Sporangia forming an æthalium; capillitium consisting of even or wrinkled branching colourless tubes.

This order contains the single genus *Lycogala*.

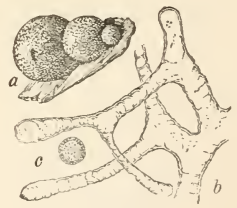

Fig. 51.—*Lycogala miniatum* Pers.
a. Three æthalia. Natural size.
b. Capillitium. Magnified 150 times.
c. Spore. Magnified 600 times.

Fig. 51.

Genus 43.—**LYCOGALA** Micheli, Nov. Pl. Gen., p. 215 (1729). Æthalia subglobose or conical, with a cortex consisting of two or more closely combined layers of different structure, the outer containing large cell-like vesicles, either enclosed or superficial, and traversed by interlacing double-walled threads, which penetrate the homogeneous inner layer at numerous points, their inner walls only being continuous with the tubes of the capillitium; capillitium grey or colourless, of wrinkled or nearly smooth branching tubes, attached to all parts of the cortex, with numerous rounded free ends. Isolated vesicles filled with granular matter are often found scattered among the spores.

The plasmodium of *Lycogala miniatum* first rises from the wood as a group of small coral-red papillæ, which soon extend to form a cushion-like mass of closely convoluted veins or sporangia; these are

more or less separated from each other by narrow tubular air-passages. Sections of such an æthalium, when hardened and stained, show the inner veins to measure from 40 to 50 μ diam., while the more superficial veins are about 100 μ diam. At a later stage the outer convolutions become deeply lobed, flattened and folded on themselves ; tubular air-passages are enclosed between the folds, which, together with the deeper air-passages and the surface of the æthalium, are bounded by a delicate membrane. At a still later stage, when the cortex is forming, the periphery is differentiated into two layers, an outer and an inner. The former bears on its surface isolated thick-walled lobes or vesicles, 20 to 200 μ diam., containing nucleated, deeply-staining protoplasm ; the nuclei remain sharply defined till after the spores are formed in the æthalium, when they degenerate and disappear. This outer layer consists of unstaining, hyaline substance, destitute of nuclei, and traversed by thick-walled interlacing air-passages. The inner layer is finely granular, faintly staining, homogeneous, and devoid of nuclei ; through it the air-passages of the cortex communicate with those of the interior ; the latter remain thin-walled, and form the so-called capillitium. In examining a young æthalium after the cortex has formed, but some hours before the karyokinetic division of nuclei, preparatory to the formation of spores, takes place, the capillitium tubes are found to be completely formed, and are filled with air, though lying in the fluid sporeplasm. This appearance shows that they are the air-spaces which existed among the convoluted sporangia when producing the æthalium, bounded by a membrane corresponding to sporangium-walls. In *L. flavo-fuscum* this membrane is more delicate than in *L. miniatum*, and is in some parts perforated with irregular lattice-work openings. The presence of spores in the tubes, which is occasionally found in *L. flavo-fuscum*, may be explained by the penetration of sporeplasm through such openings.

KEY TO THE SPECIES OF *LYCOGALA*.

Cortex of æthalia smooth or areolated.	1. *L. flavo-fuscum*
Cortex of æthalia warted—	
Æthalia subglobose.	2. *L. miniatum*
Æthalia conical.	3. *L. conicum*

1. **L. flavo-fuscum** Rost., Versuch., p. 3 (1873). Plasmodium ? Æthalia rounded, sessile, or subpyriform, and shortly stalked, 2 to 5 cm. diam., ochraceous-brown or purplish-brown, smooth, minutely areolated; cortex thick, of three layers, the outer membranous, the middle consisting of a dense aggregation of yellow vesicles, 50 to 80 μ diam., intermixed with the peripheral ends of the capillitium, the inner layer homogeneous, pierced by the capillitium threads; mass of capillitium and spores pale buff. Capillitium of irregularly branching, nearly colourless, wrinkled tubes, 6 to 20 μ diam., or more, with numerous blunt-ended free branches. Spores almost colourless, minutely reticulated over the greater part of the surface, 5 to 6 μ diam.—Mon., p. 288; Cooke, Myx. Brit., p. 76; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 127 ; Mass. Mon., p. 124; Zopf, in Schenk, Handb. der Bot., iii., 2, p. 167. *Diphtherium flavo-fuscum* Ehrenberg, Sylv. Myc. Berol., pp. 14, 27 (1818).

Plate LXXV., A.—*a.* æthalium, natural size; *b.* reticulated surface of cortex, × 20; *c.* vertical section of cortex; (1) outer layer composed of interwoven, empty, flattened tubes; (2) vesicles containing yellow or reddish-yellow matter, with the interspaces between them traversed by tubular processes, which are more or less continuous with the capillitium; (3) homogeneous inner layer, perforated by the capillitium, × 80; *d.* capillitium consisting of empty tubes, occasionally containing spores in the rounded ends and in limited spaces in the continuity of the tubes, × 80; *e.* part of capillitium tube, showing the papillose surface, × 600; *f.* spores, showing unequally distributed reticulation, × 600 (N. America).

American specimens received from Dr. Rex and Prof. Macbride are identical in structure with those in the Strassburg Herbarium.

Hab. On dead wood.—Germany (Strassb. Herb.); Ceylon (K. 1732); Philadelphia (L:B.M.171); Ohio (L:B.M.171); Iowa (B. M. 827); S. Carolina (B. M. 838).

2. **L. miniatum** Pers., in Römer, N. Mag. Bot., i., p. 87 (1794). Plasmodium rose-red, in rotten wood. Sporangia subglobose, sessile, crowded or scattered, 2 mm. to 1 cm. diam., pinkish-grey, yellowish-brown or red-brown, minutely warted; cortex varying in thickness, with superficial vesicles. Capillitium arising from all parts of the inner side of the cortex in loosely branching and anastomosing, thin-walled tubes, varying from 3 to 20 μ diam., more or less wrinkled, with numerous free branches, clavate or rounded at the ends; mass of capillitium and spores pinkish grey. Spores almost colourless, closely reticulated over the greater part of the surface, the remaining part marked with a loose reticulation, or with short raised lines and warts, 5 to 7 μ diam.—Nees, Syst. Pilze, p. 103; Grev., Sc. Crypt. Fl., t. 38. *Lycoperdon Epidendrum* Linn., Sp. Pl., ii., p. 1184 (1753). *Lycogala Epidendrum* Rost., Versuch., p. 3 (1873); Mon., p. 285 (1875); Cooke, Myx. Brit., p. 75; Zopf, in Schenk, Handb. der Bot., iii., 2, p. 168; Blytt, Bidr. K. Norg., Sop. iii., p. 12; Macbride, in Bull. Nat. Hist. Iowa, ii., p. 127; Mass., Mon., p. 121.

Plate LXXV., B.—*a.* sporangia, natural size; *b.* surface of cortex, warted with vesicles, × 20; *c.* vertical section of cortex; (1) upper layer containing interwoven thick-walled tubes, and bearing on the surface simple or compound vesicles; (2) homogeneous inner layer, perforated by the capillitium, × 80; *d.* capillitium, consisting of empty tubes, rugose with ridges and folds, × 180; *e.* part of capillitium tube, and spores, × 600 (England).

In small æthalia the cortex is usually thin, the interlacing threads in the outer layer narrow and scanty, and the homogeneous inner layer membranous; in larger æthalia the outer layer is often 40 μ thick, and the interlacing threads broad and abundant, with gelatinous outer walls 5 to 10 μ thick: while the homogeneous inner layer sometimes exceeds 50 μ in thickness.

Hab. On dead wood. Common.—Wilts (B. M. 1, 6); Lyme Regis, Dorset (L:B.M.172); Orton Wood, Leicestershire (B.M.); France (B. M. 733); Germany (B. M. 728); Poland (Strassb. Herb.); Norway (B. M. 734); Finland (B. M. 732); Italy (B. M. 737); Bermuda (B. M. 745); Philadelphia (L:B.M.172); Iowa (L:B.M.172); Island of St. Thomas, Africa (B. M. 1156); Ohio (L:B.M.172); S. Carolina (B. M. 841); Texas (B. M. 841*a*); French Guiana (Paris Herb.); Brazil (Paris Herb.).

3. **L. conicum** Pers., Syn., i., p. 159 (1801). Plasmodium rose-red, in rotten wood (teste Dr. Rex). Æthalia conical, sessile on a broad base, crowded or scattered, 1·5 to 3 mm. high, 0·8 to 1·5 mm. broad, sometimes subglobose, yellow-brown; the dark confluent superficial vesicles forming spots or a broken reticulation, chiefly on the upper part; cortex thin, of two closely combined layers, the outer traversed by flattened threads 2 to 10 μ broad, either loosely interlacing, or more often nearly parallel in a single series, and separated by intervals of 2 to 20 μ, piercing the membranous inner layer and continuous with the capillitium. Capillitium of simple, rarely branching, olivaceous-grey threads, 3 μ diam., or varying from 2 to 7 μ, faintly and minutely wrinkled, with clavate or obtuse ends. Spores, in mass, yellowish-grey or ochraceous, minutely reticulated over the greater part of the surface, 4 to 5 μ diam.—Fries, Syst. Myc., iii., p. 82; Mass., Mon., p. 123. *Dermodium conicum* Rost., Mon., p. 284.

Plate LXXVI., A.—*a.* æthalia, × 20; *b.* part of cortex; (1) outer membranous layer, bearing on the surface irregularly shaped vesicles containing dark granular matter, traversed by empty flattened tubes, having a somewhat parallel arrangement; (2) homogeneous inner layer, perforated by the narrow capillitium tubes, × 180; *c.* part of capillitium tube, and spores, × 600 (Ohio, U.S.A.).

This description is taken from specimens received from Dr. Rex under the name of *Dermodium conicum*, and from Mr. Morgan under the name of *Lycogala conicum*; they were gathered in Fairmount Park, Philadelphia, and at Preston, Ohio. They differ from *L. miniatum* in the uniformly small size and more or less conical shape, in the scanty seldom branching somewhat parallel threads in the thin outer layer of the cortex, and in the almost simple threads of the capillitium: very similar structure is met with, however, in minute thin-walled æthalia of *L. miniatum*, showing the close alliance of the two species; but such small æthalia of *L. miniatum* are usually found in company with others of more ordinary dimensions, and differ in shape and in the arrangement of the warts from the American specimens. The type specimen of *L. nitidum* Berk. & Br., from Ceylon (K. 1729), is referred to by Rostafinski as being *Dermodium conicum* (Mon., App., p. 37); the cortex is thin, and traversed by broad and narrow threads, more interwoven than in the specimens from America; but the æthalia are hard and immature, and are valueless in the determination of specific characters.

Hab. On dead wood.—Philadelphia (L:B.M.173); Ohio, U.S.A. (L:B.M.173).

SPECIES NOT MET WITH IN THE QUOTED COLLECTIONS.

4. **L. minutum** Sacc. et Paol., in Atti R. Instit. Ven. Sci., ser. 6, vol. vi., p. 5. Sporangia gregarious, superficial, sessile on an adnate base, globoso-depressed, yellowish-ochre coloured, 4 to 5 mm. diam., smooth, not punctate, at length minutely and closely pitted; hypothallus scanty, white, mucedinous; capillitium threads filiform, short, hyaline, almost simple; spores globose, asperulate, pale yellow, 3 μ diam.

Hab. On rotten decorticate branches.—Malacca.

SPECIES EXCLUDED FROM THE MYCETOZOA.

L. rufo-cinnamomeum Mass., Mon., p. 125, from S. Africa (K. 1735), has the cortex on the peridium, consisting of a dense uniform tissue of hyphæ, in which occasional septa are to be seen; the spores are dark brown, warted, 5 to 7 μ diam., often showing a short stalk.

L. ochraceum Mass., Mon., p. 125, from Java (K. 1737), consists of a mass of branching hyphæ, bearing numerous pale warted spores 3 μ diam.

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A

CERATIOMYXA MUCIDA Schroet.

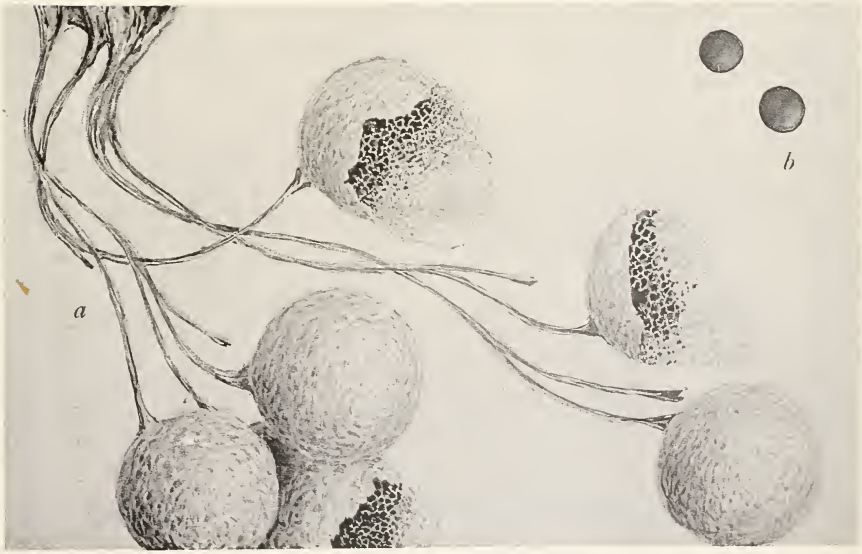
B

Lister pinx.

BADHAMIA HYALINA Berk

BADHAMIA UTRICULARIS Berk.

B

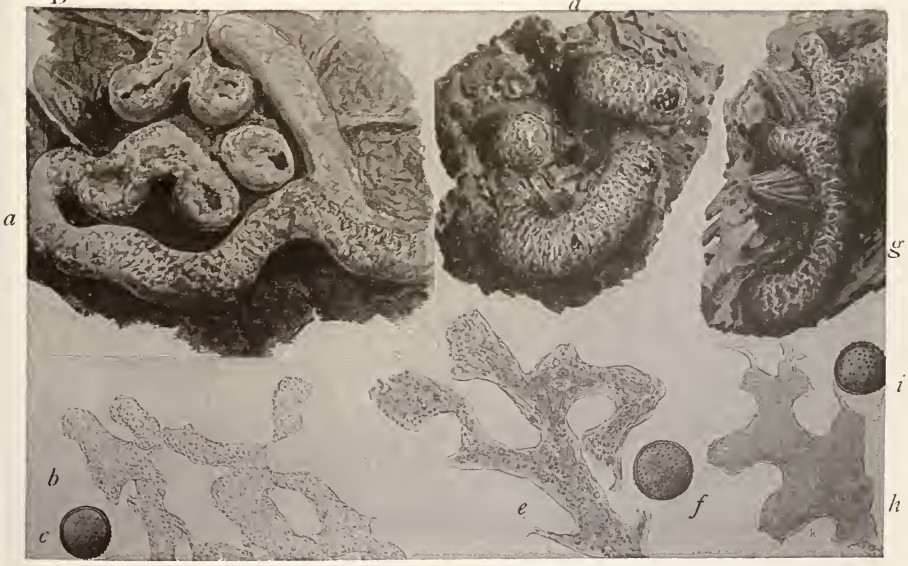


Lister pinx.

BADHAMIA MAGNA Peck

BADHAMIA NITENS Berk.

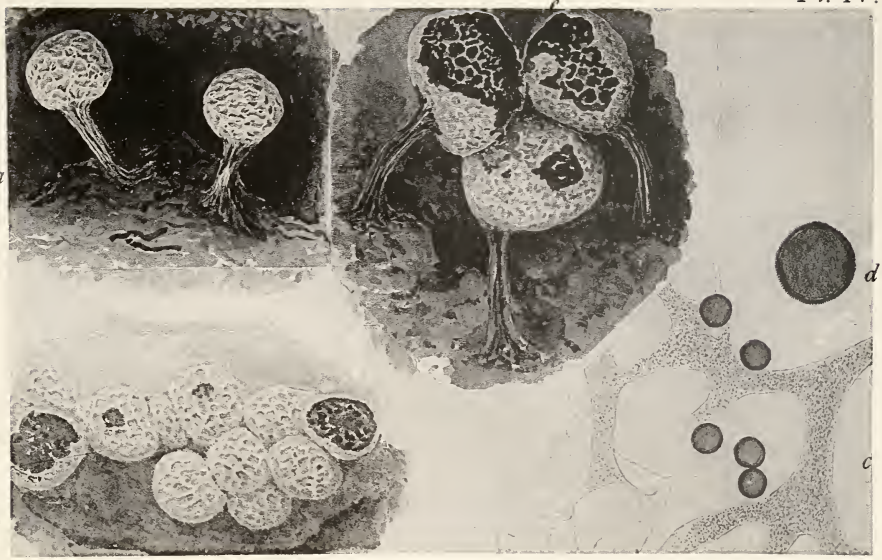
B



Lister pinx.

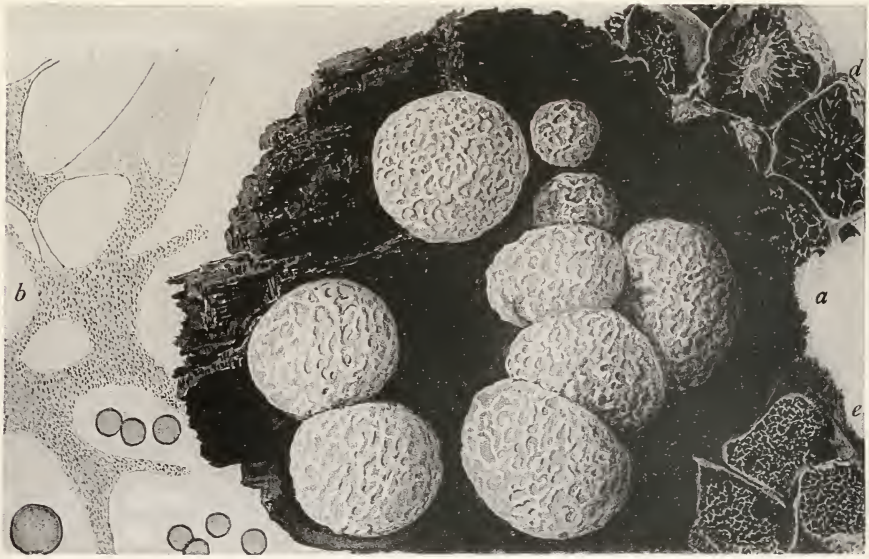
BADHAMIA DECIPIENS Berk.

A



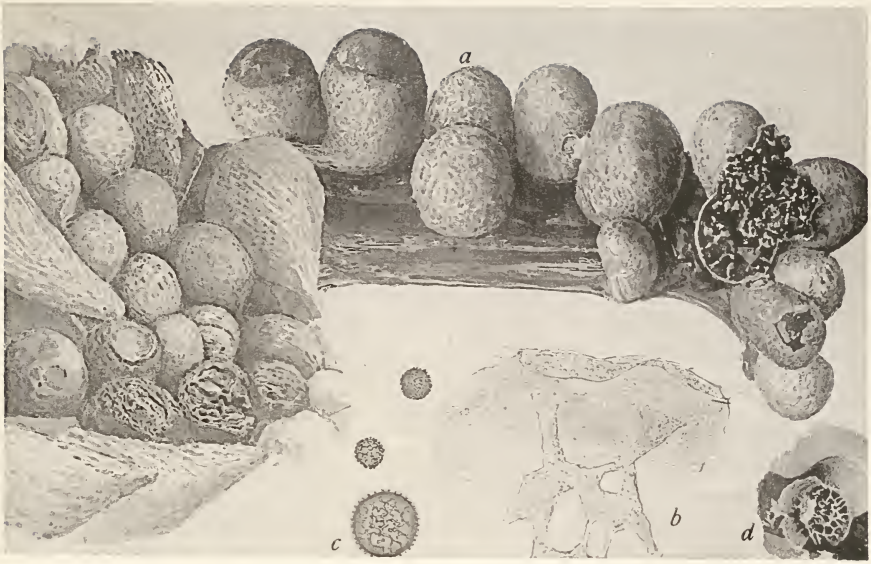
BADHAMIA MACROCARPA Rost.

B



Lister pinx.

BADHAMIA PANICEA Rost.

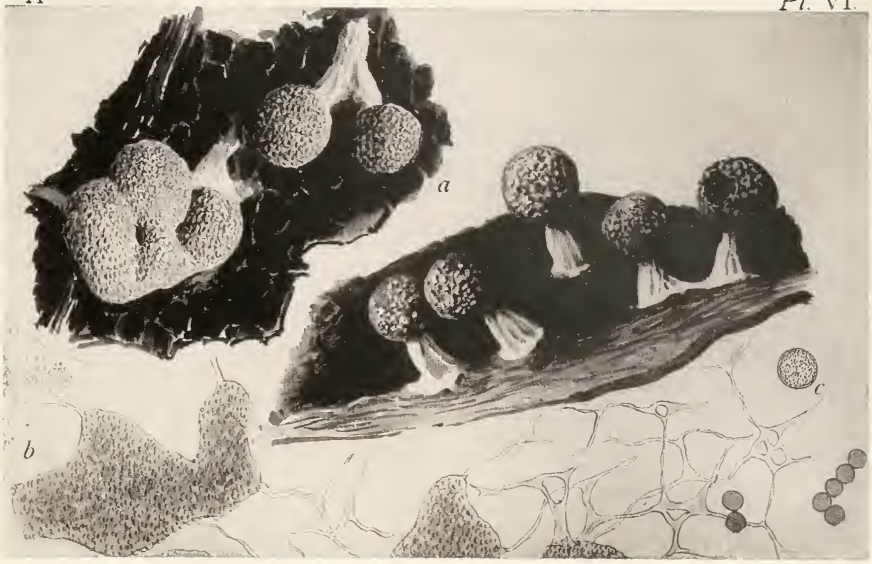


BADHAMIA LILACINA Rost.

B

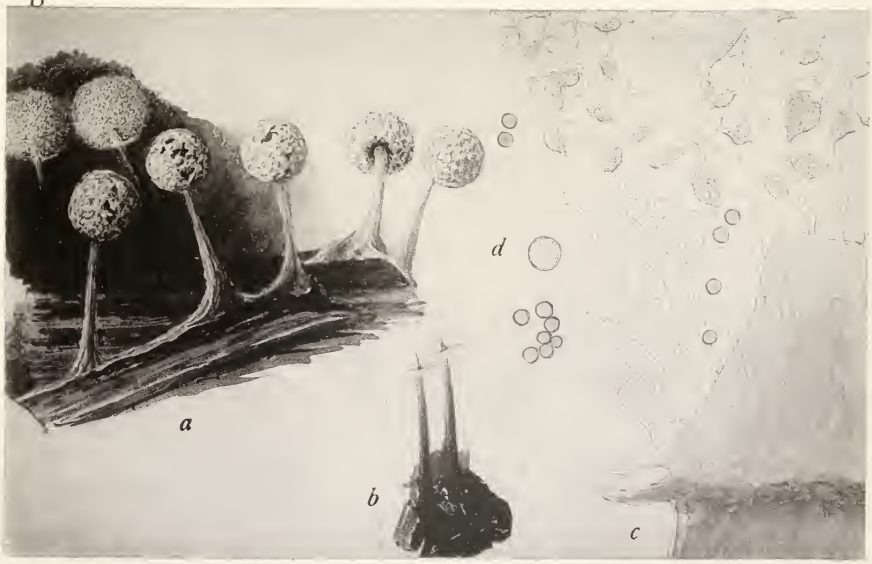
Lister pinx.

BADHAMIA RUBIGINOSA Rost.



PHYSARUM LEUCOPUS Link

B



Lister pinx.

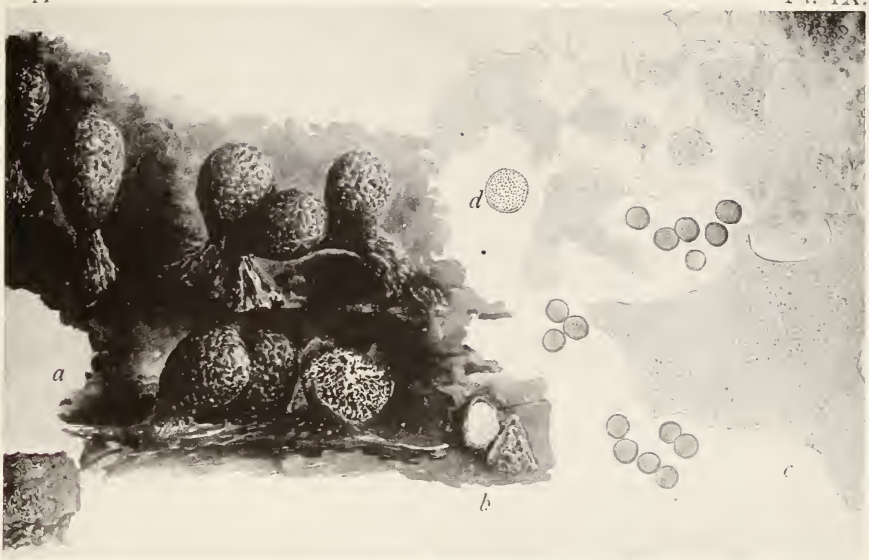
PHYSARUM GLOBULIFERUM Pers.

PHYSARUM PULCHRIPES Peck

B

Lister pinx

PHYSARUM MURINUM List.



PHYSARUM VARIABILE Rex

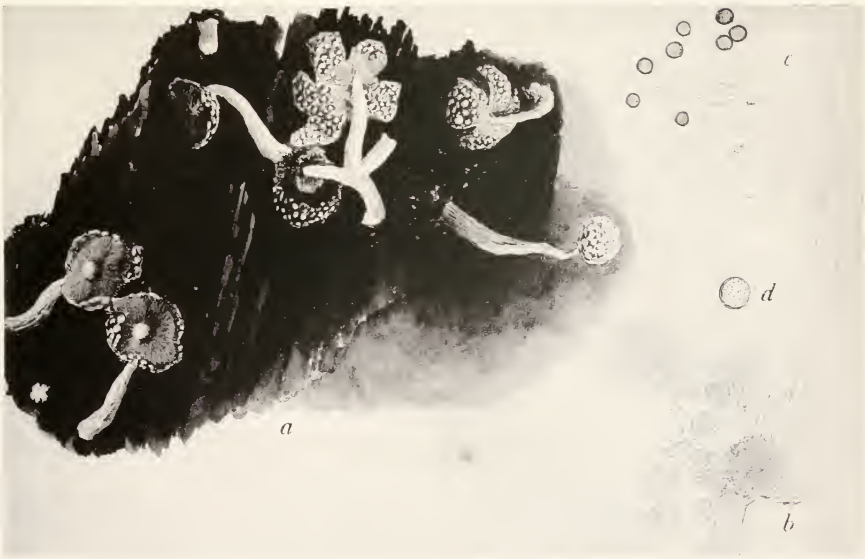
B

Lister pinx.

PHYSARUM MELLEUM Mass.

PHYSARUM TENERUM Rex

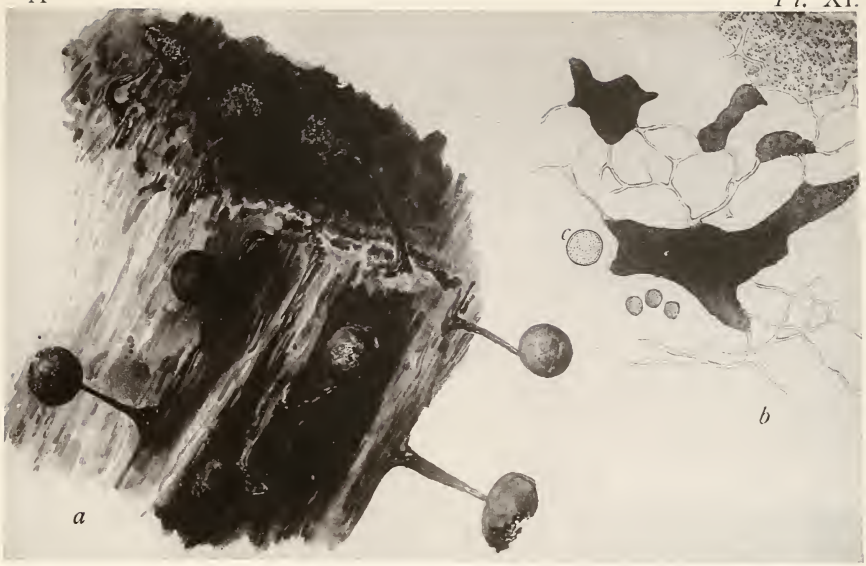
B



Lister pinx.

PHYSARUM COMPACTUM List.

A



PHYSARUM ROSEUM Berk. & Br.

B

Lister pinx

PHYSARUM PSITTACINUM Ditm.

PHYSARUM VIRIDE Pers.

B

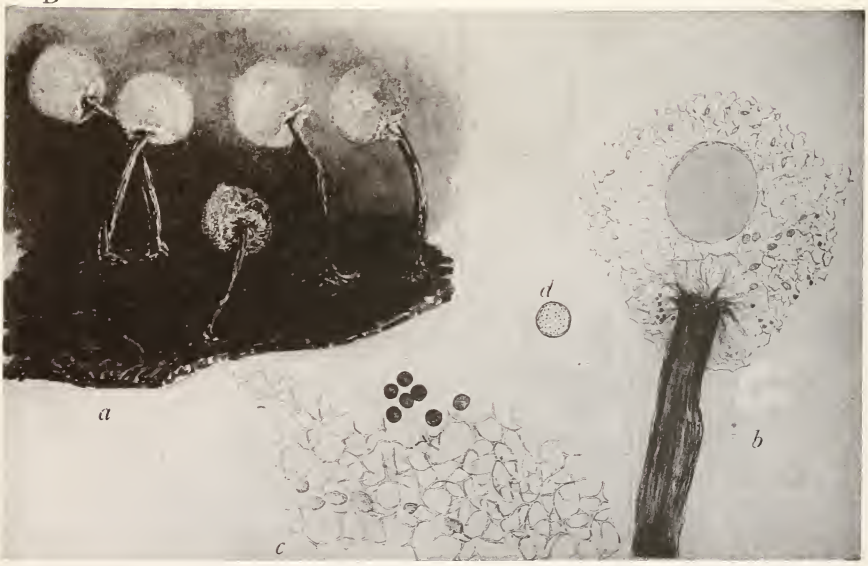
Lister pinx.

PHYSARUM BERKELEYI Rost.

A

PHYSARUM POLYMORPHUM Rost.

B



Lister pinx

PHYSARUM NUCLEATUM Rex

A

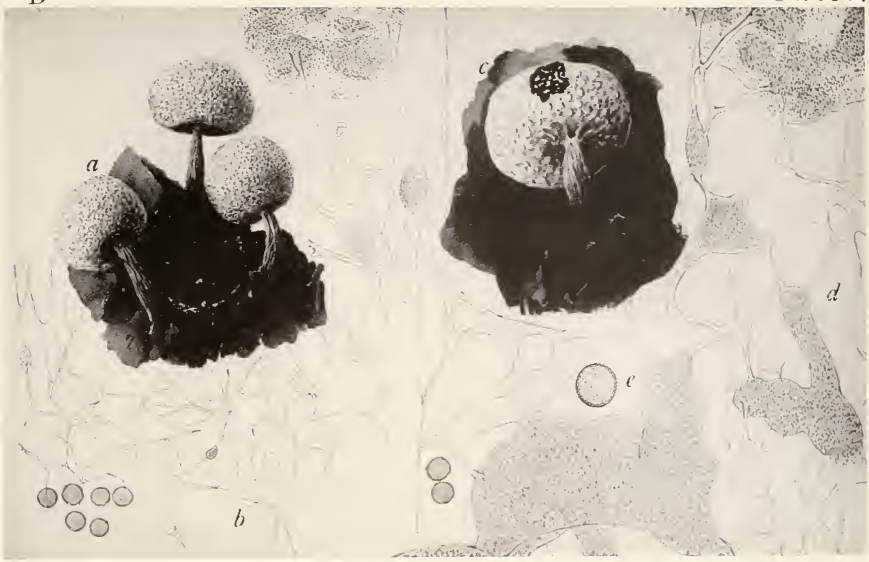
PHYSARUM PENETRALE Rex

B

Listerpinx.

PHYSARUM CALIDRIS List

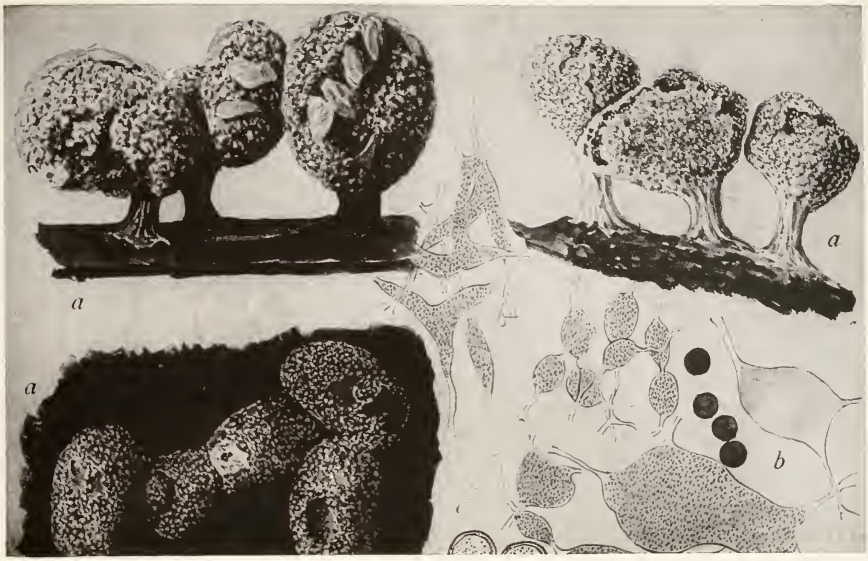
B



A

Lister punx

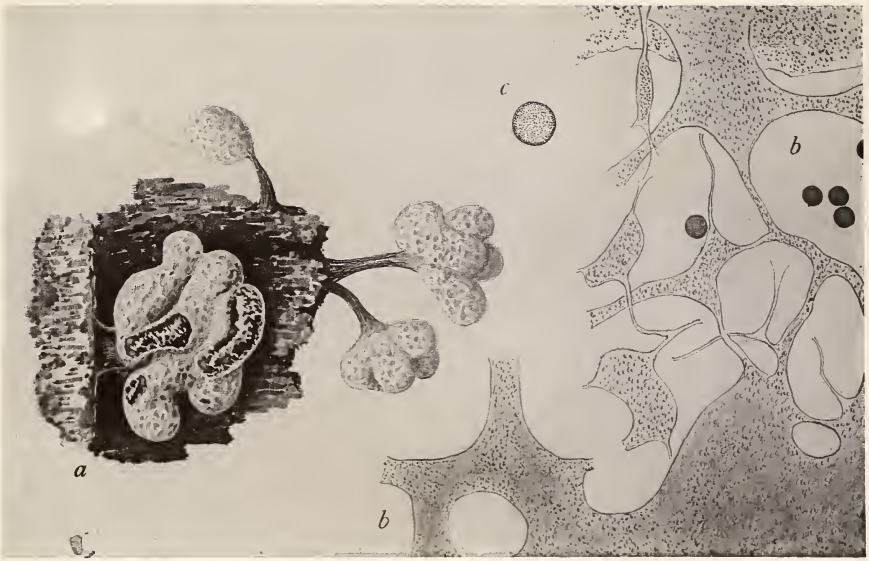
A, B. PHYSARUM NUTANS Pers.



B

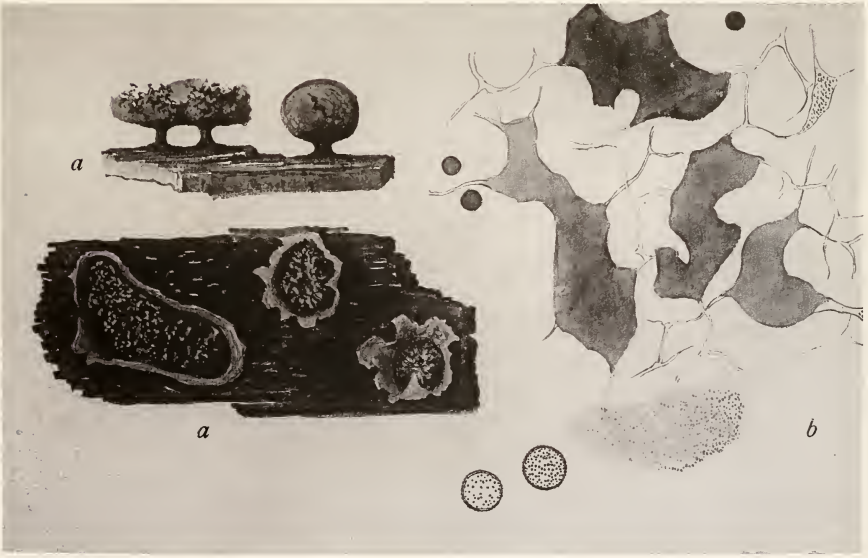
Lister pinx.

A. B PHYSARUM COMPRESSUM Alb. & Schw.



PHYSARUM COMPRESSUM A. & S. (P. NICARAGUENSE Macbr.)

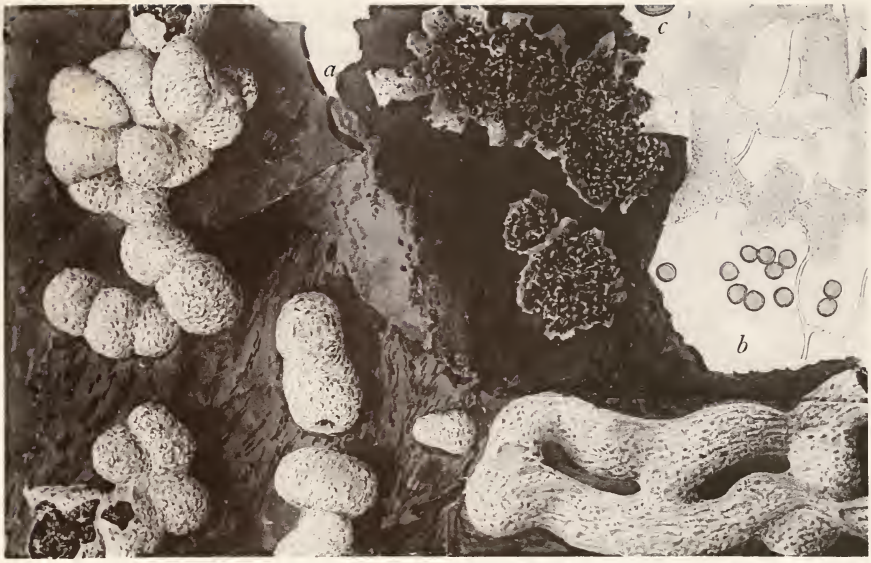
B



Lister pinx

PHYSARUM NEWTONI Macbr.

A

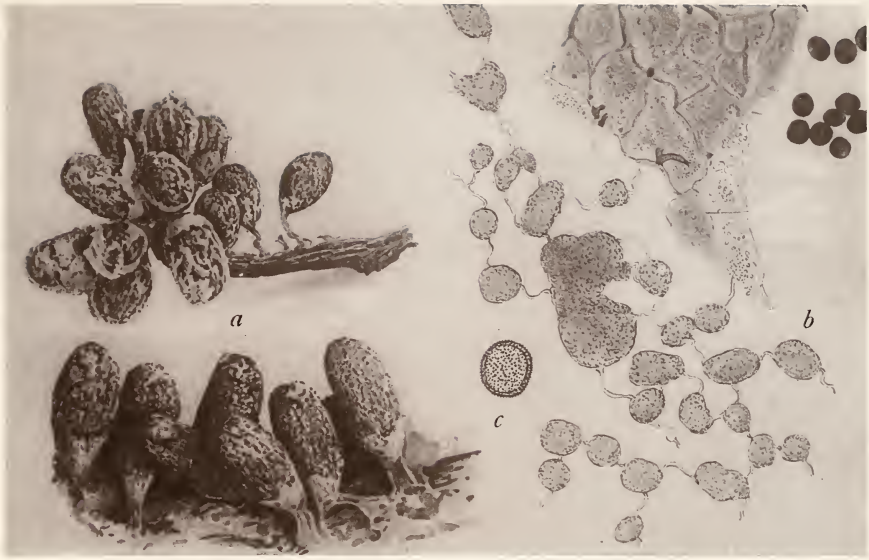


PHYSARUM CINEREUM Pers.

B

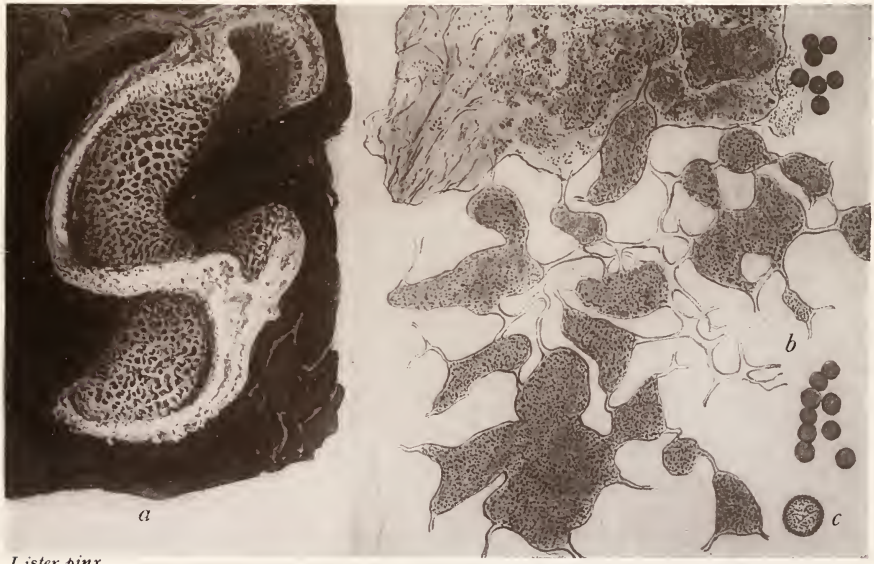
Lister pinx.

CRATERIACHEA MUTABILIS Rost.



PHYSARUM DIDERMOIDES Rost.

B

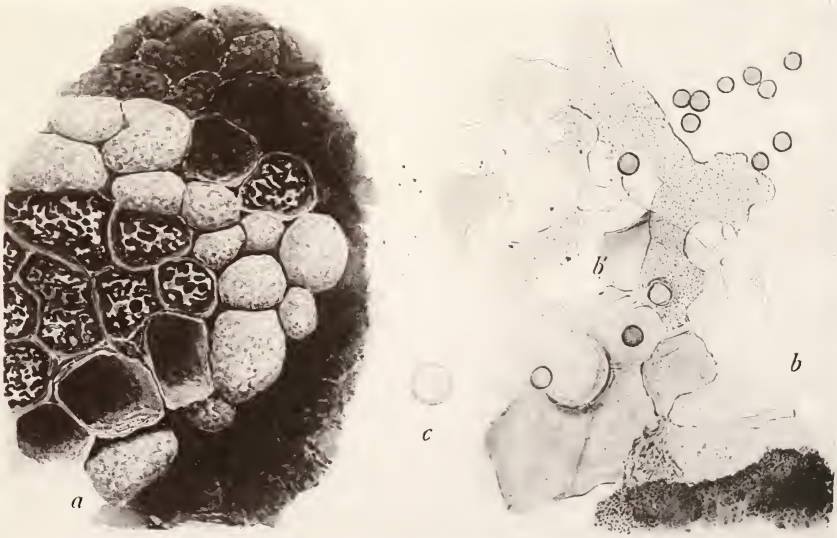


Lister pinx.

PHYSARUM BIVALVE Pers.

PHYSARUM CONTEXTUM Pers.

B



Lister pinx

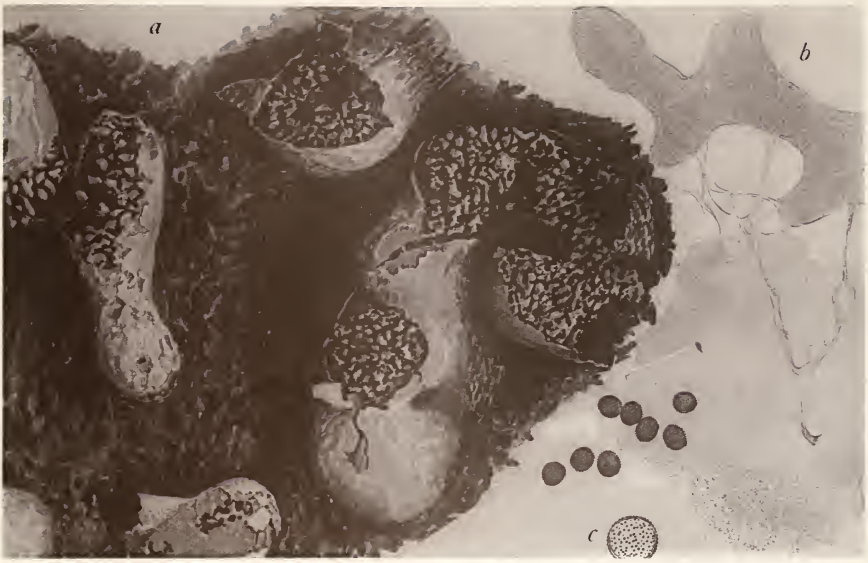
PHYSARUM CONGLOMERATUM Rost.

PHYSARUM VIRESCENS Ditm.

B

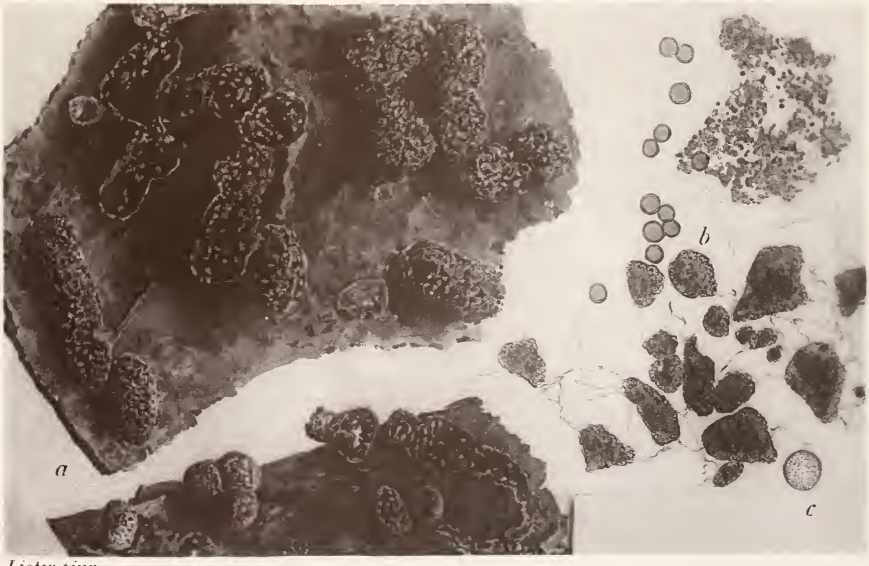
Lister pinx.

PHYSARUM VIRESCENS Var. OBSCURUM



PHYSARUM DIDERMA Rost.

B



Lister pinx.

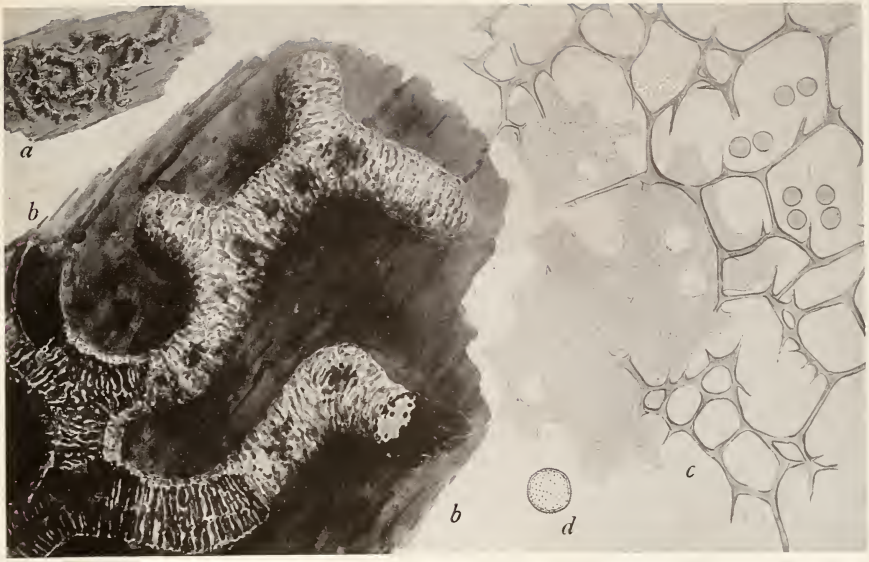
PHYSARUM INÆQUALE Peck

PHYSARUM RUBIGINOSUM Fr.

B

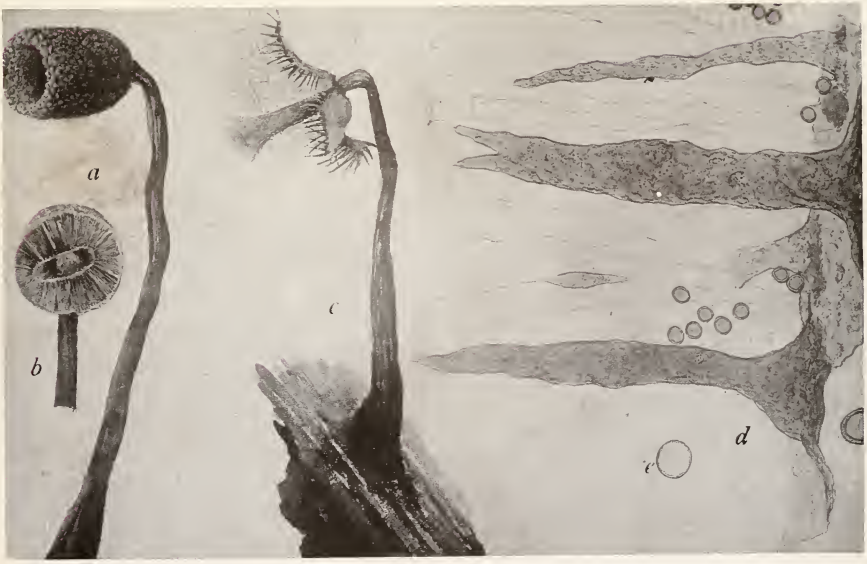
Lister pinx.

PHYSARUM AURISCALPIUM Cooke



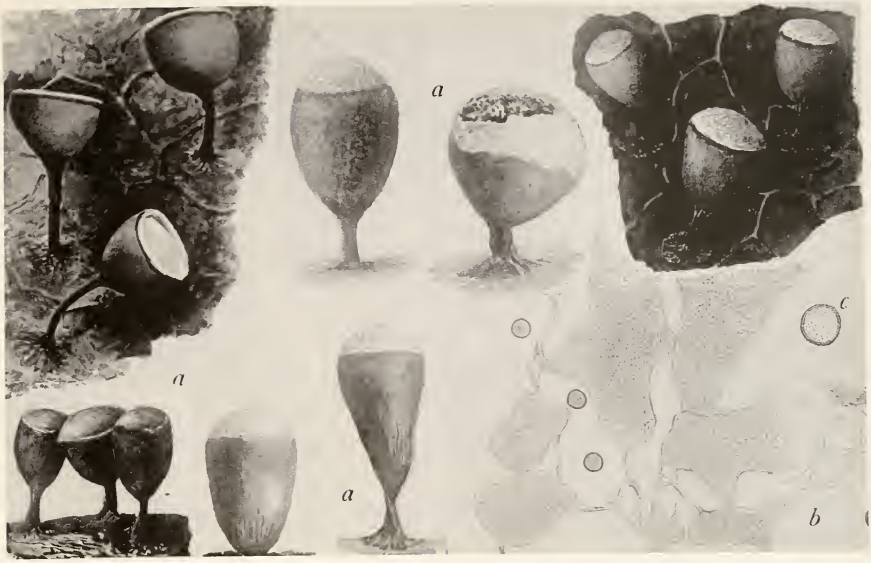
CIENKOWSKIA RETICULATA Rost.

B



Lister pinx

PHYSARELLA MIRABILIS Peck



CRATERIUM PEDUNCULATUM Trent.

B

Luster pinx.

CRATERIUM CONCINNUM Rex

CRATERIUM RUBESCENS Rex

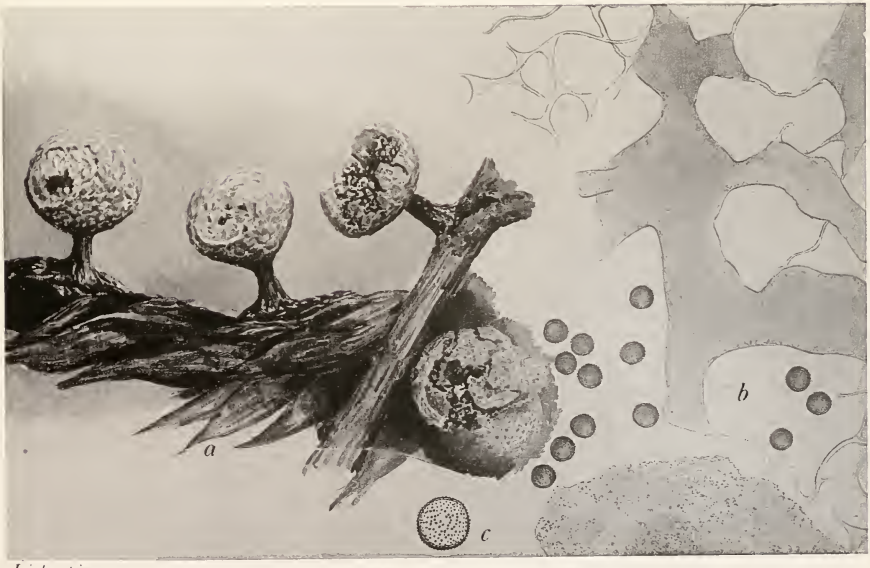
B

Lister fmx.

CRATERIUM LEUCOCEPHALUM Ditm.

CRATERIUM MUTABILE Fr.

B



Lister pinx.

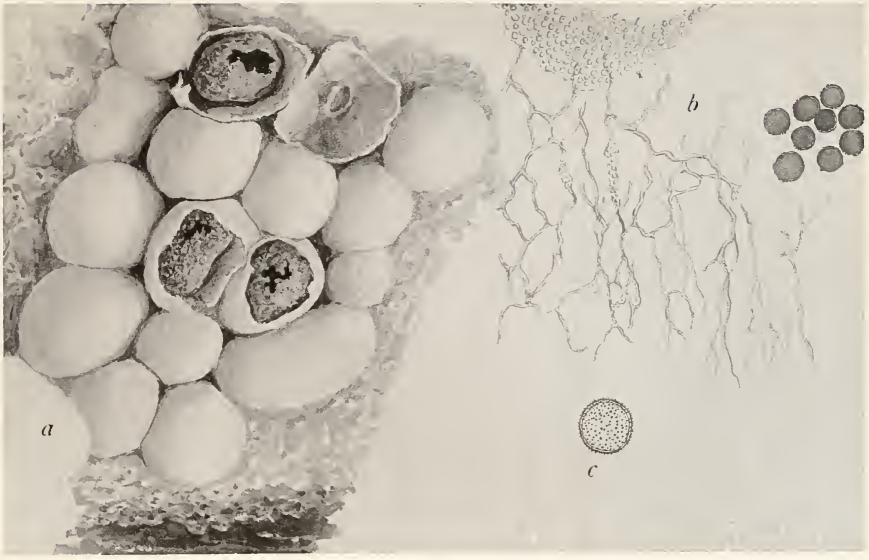
CRATERIUM CITRINELLUM List.

LEOCARPUS VERNICOSUS Link

B

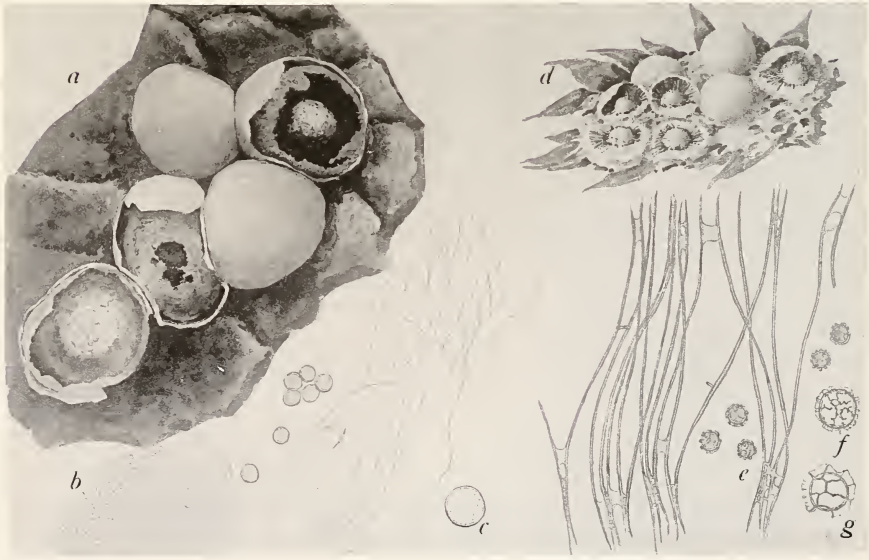
Lister pinx.

CHONDRIODERMA SPUMARIOIDES Rost.



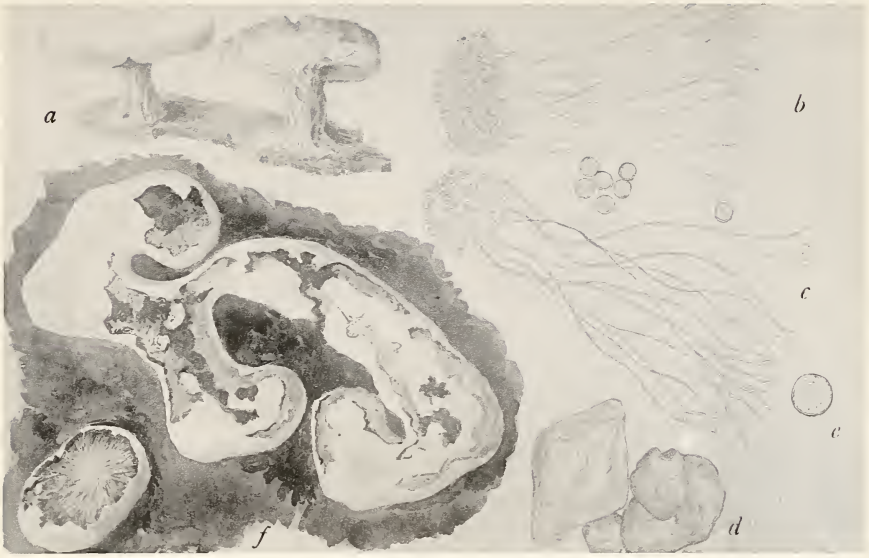
CHONDRIODERMA GLOBOSUM Rost

B



Lister pinx.

a—c CHONDRIODERMA TESTACEUM Rost.
d—g CHONDRIODERMA SUBDICTYOSPERMUM Rost.



a—*e* CHONDRIODERMA MICHELII Rost.
f CHONDRIODERMA RETICULATUM Rost.

B

Lister pinx.

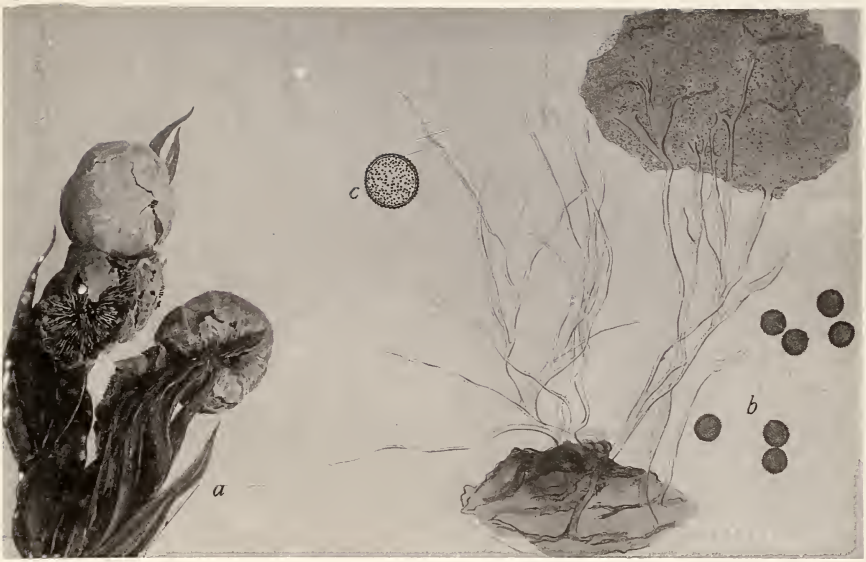
CHONDRIODERMA NIVEUM Rost.

CHONDRIODERMA LYALLII Mass.

B

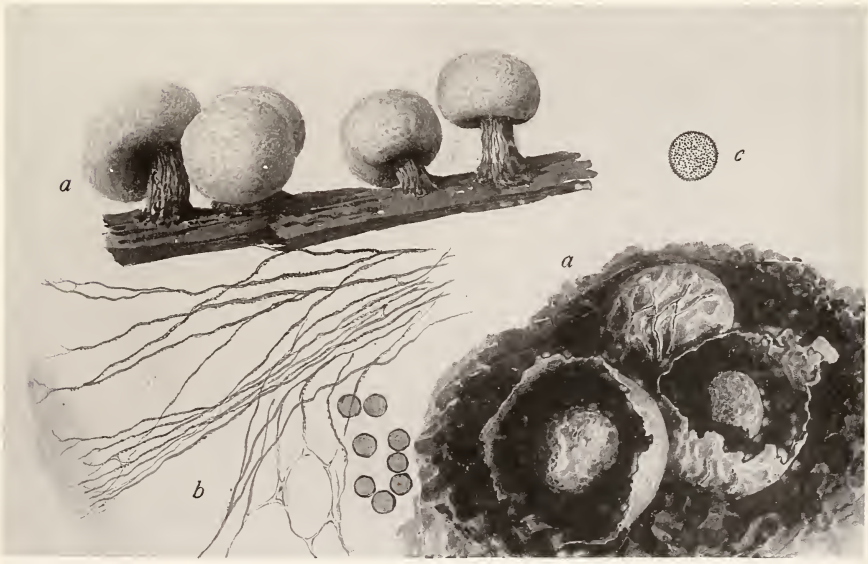
Lister pinx.

CHONDRIODERMA TREVELYANI Rost.



CHONDRIODERMA SAUTERI Rost.

B



Lister pinx.

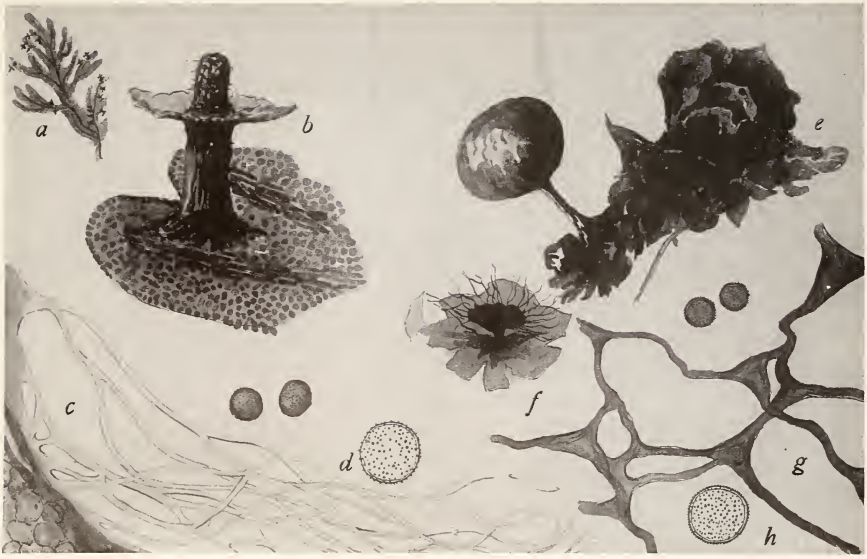
CHONDRIODERMA RADIATUM Rost.

CHONDRIODERMA RUGOSUM Rex

B

Lister pinx

CHONDRIODERMA FLORIFORME Rost.

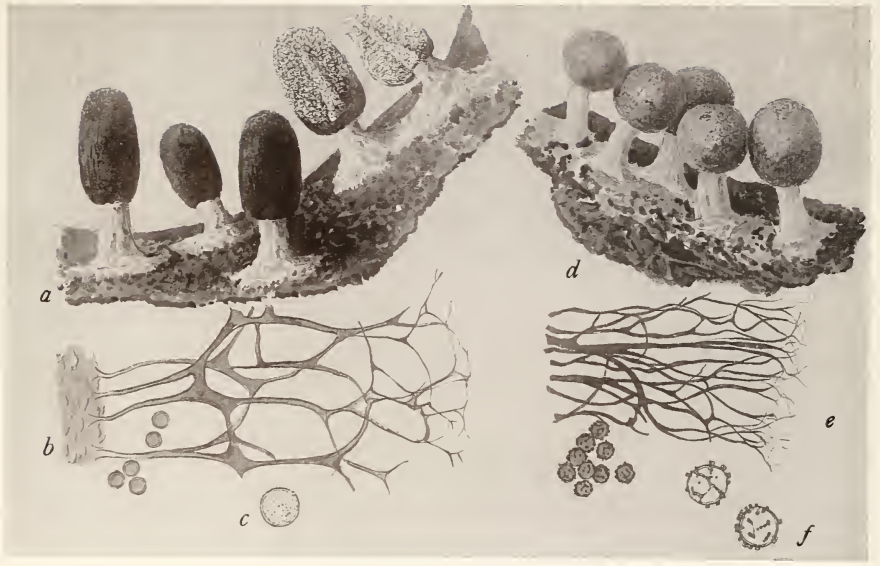


a—*d* CHONDRIODERMA HOOKERI List.
e—*h* CHONDRIODERMA LUCIDUM Cooke

B

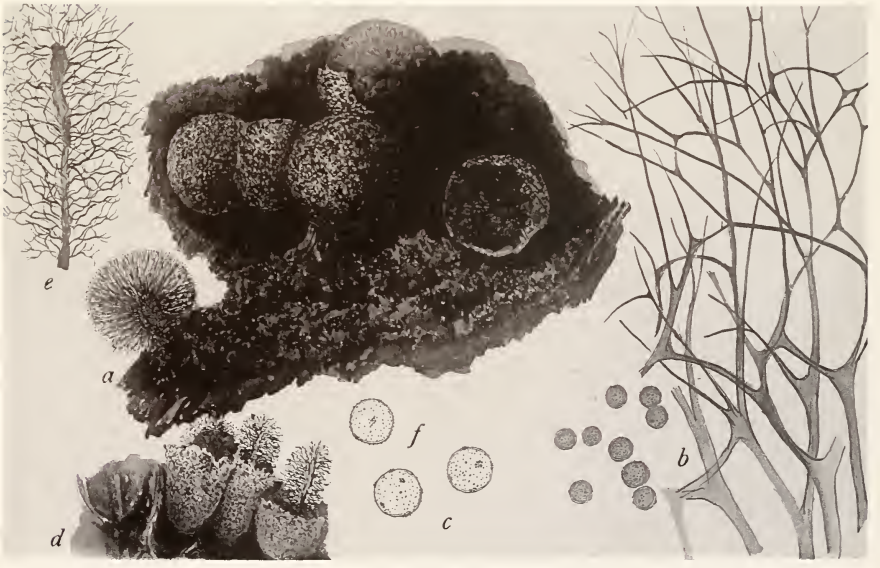
Lister pinx.

TRICHAMPHORA PEZIZOIDEA Jungh.



a—c DIACHÆA ELEGANS Fr.
d—f DIACHÆA SPLENDENS Peck

B



Lister pinx

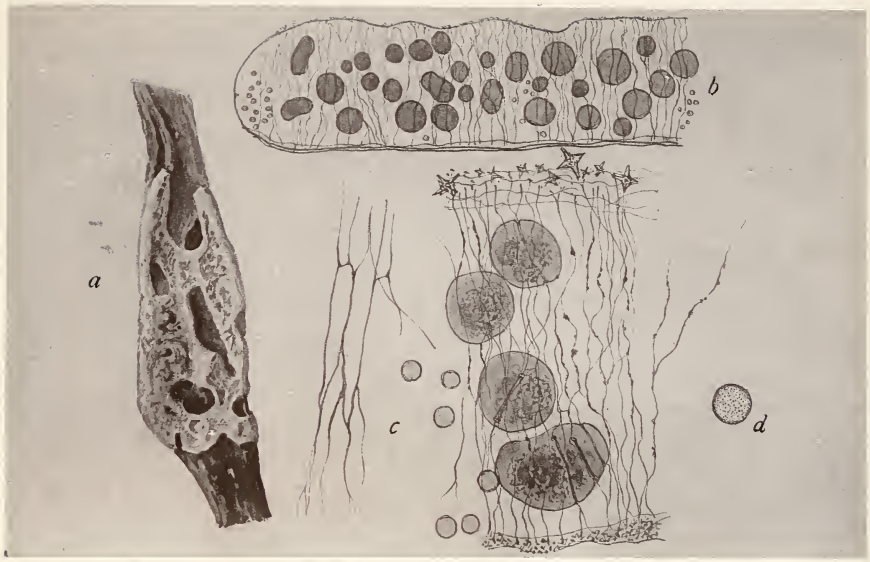
DIACHÆA THOMASII Rex

DIDYMIUM DIFFORME Duby

B

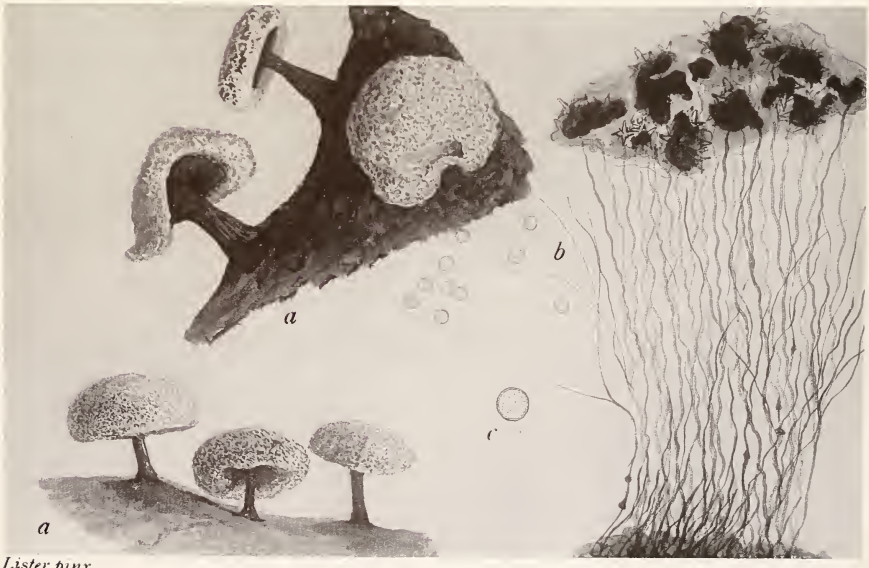
Lister pinx.

DIDYMIUM DUBIUM Rost.



DIDYMIUM SERPULA Fr.

B



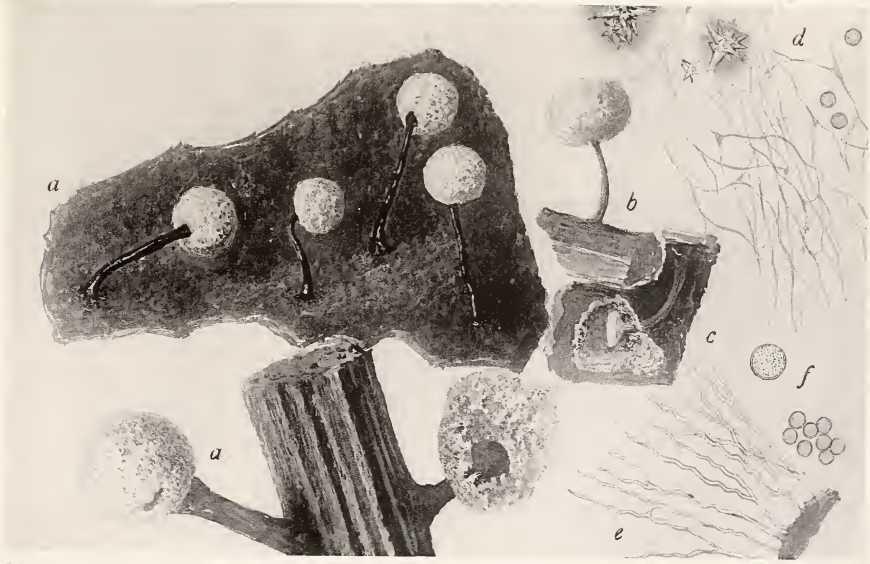
Lister pinx.

DIDYMIUM CLAVUS Rost.

A

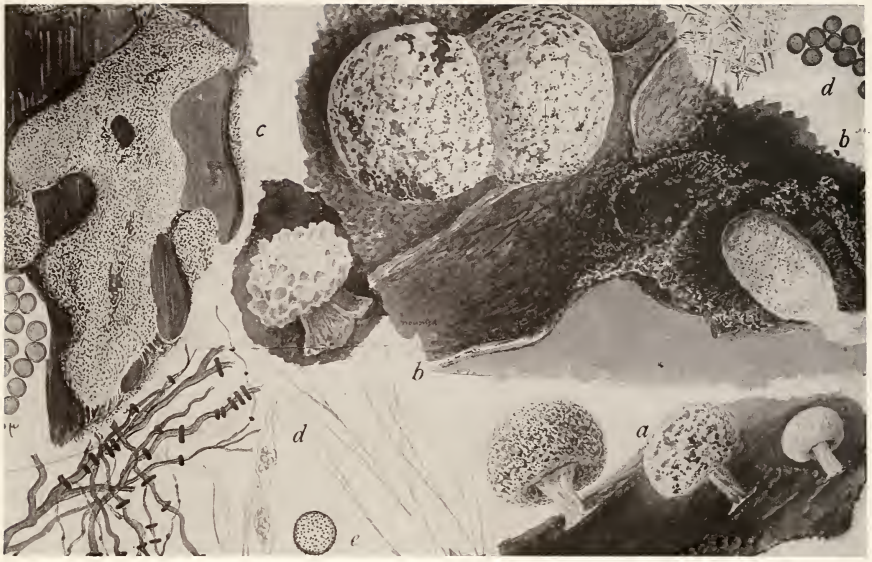
DIDYMIUM FARINACEUM Schrad.

B



Lister pinx.

DIDYMIUM NIGRIPES Fr.

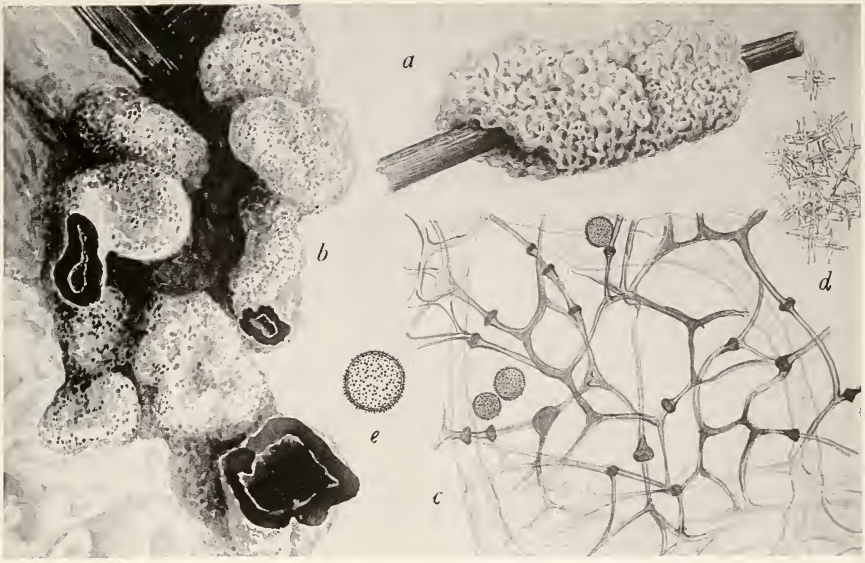


DIDYMIUM EFFUSUM. Link

B

Lister pinx.

DIDYMIUM CRUSTACEUM Fr.



SPUMARIA ALBA D.C.

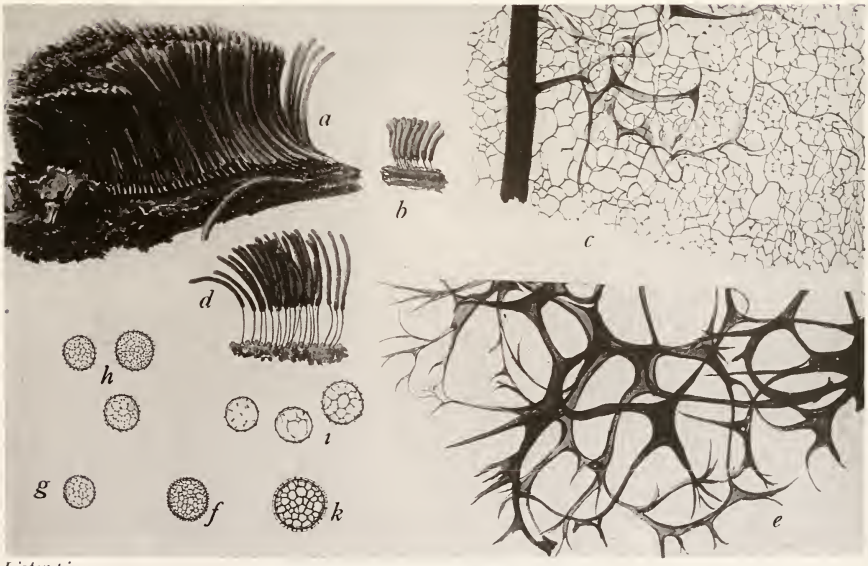
B

Lister pinx.

a—d LEPIDODERMA TIGRINUM Rost.
e—f LEPIDODERMA CARESTIANUM Rost.

DIDYMIUM GRANULIFERUM Phillips

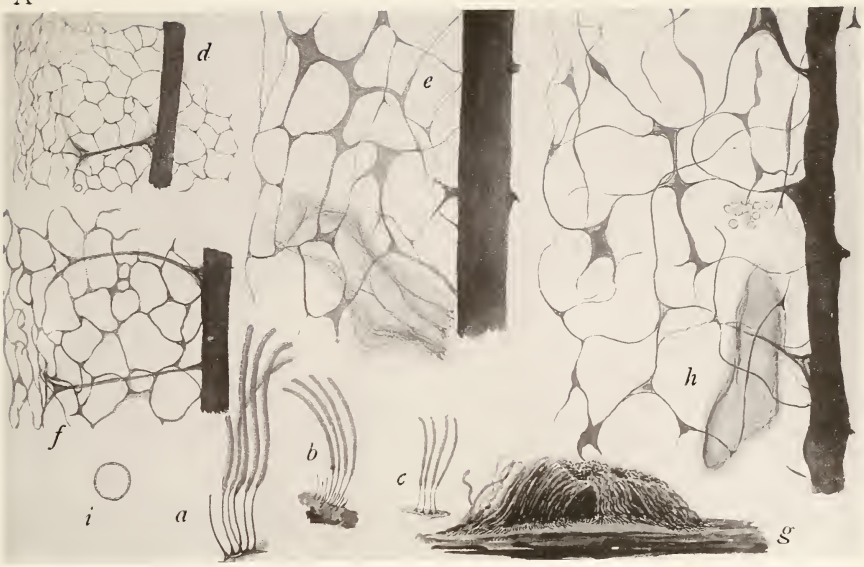
B



Lister pinx.

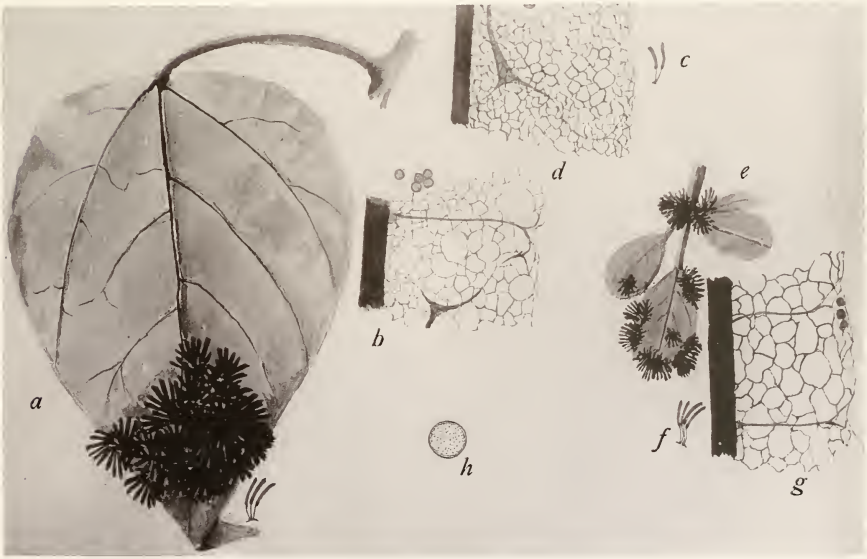
STEMONITIS FUSCA Roth

A



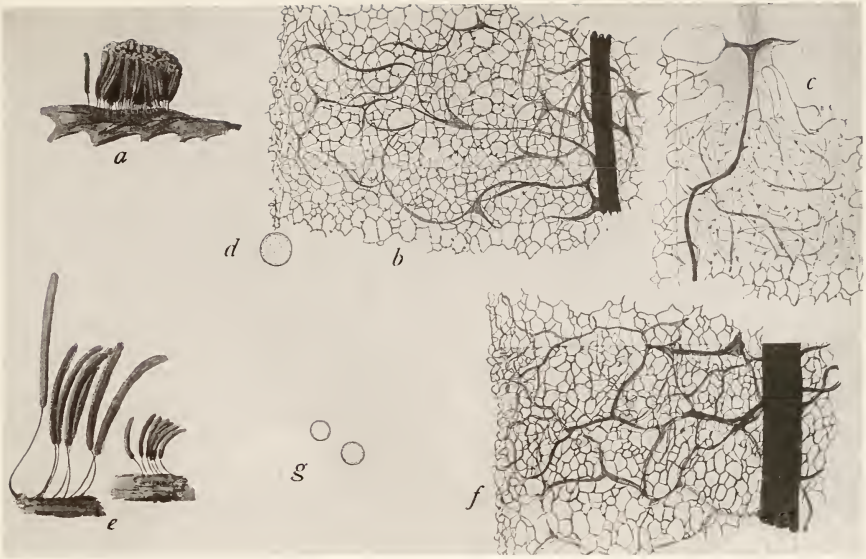
STEMONITIS SPLENDENS Rost.

B



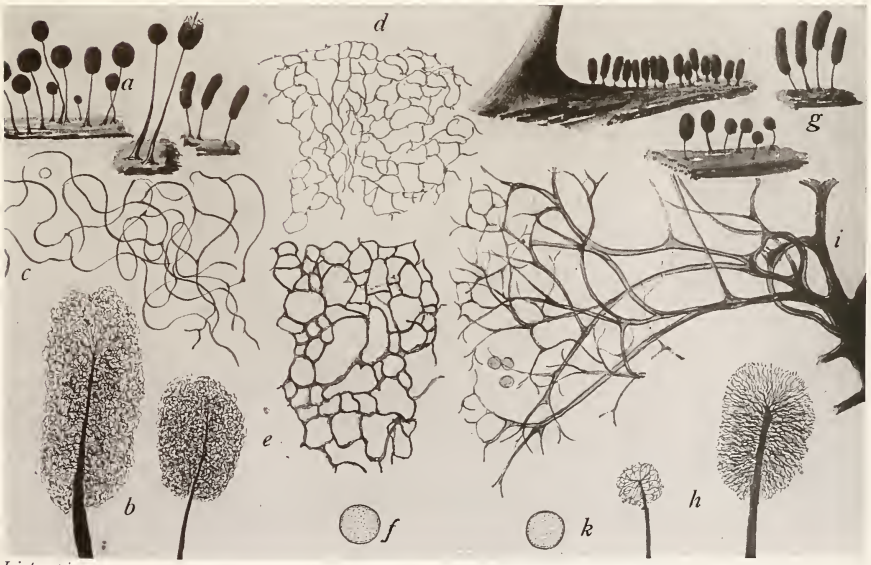
Lister pinx.

STEMONITIS HERBATICA Peck



a—d STEMONITIS FERRUGINEA Ehrenb.
e—f STEMONITIS SMITHII Macbr.

B

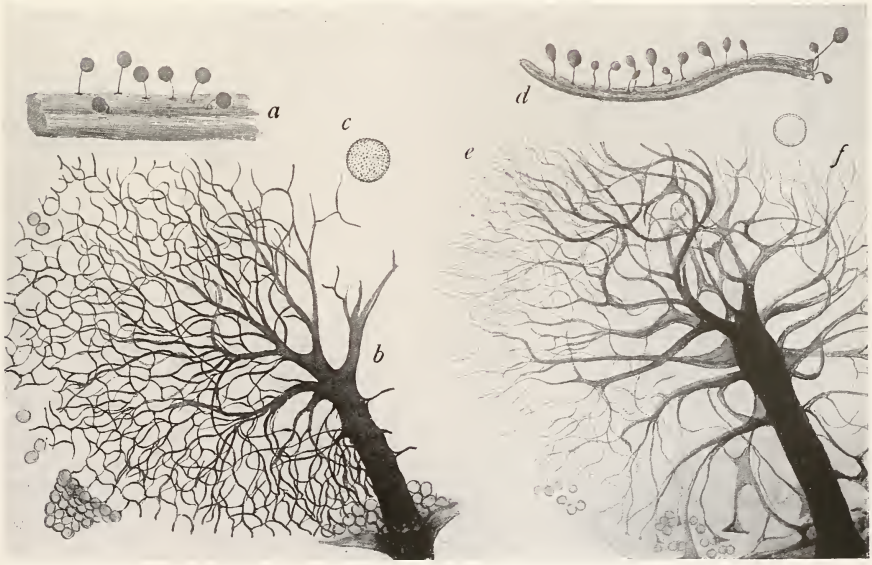


Lister pinx.

a—f COMATRICHA OBTUSATA Preuss
g—k COMATRICHA LAXA Rost.

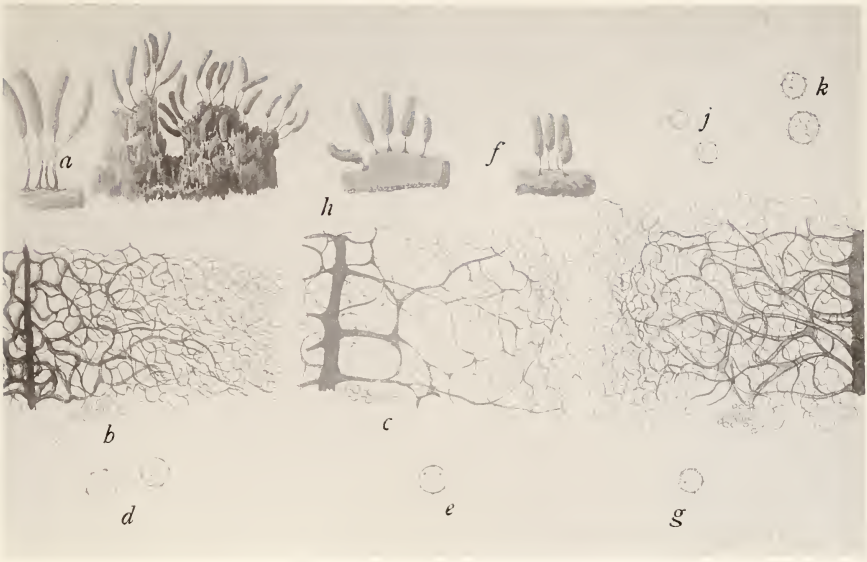
a—e COMATRICHA LONGA Peck
f—i COMATRICHA LONGA Var. IRREGULARIS

B



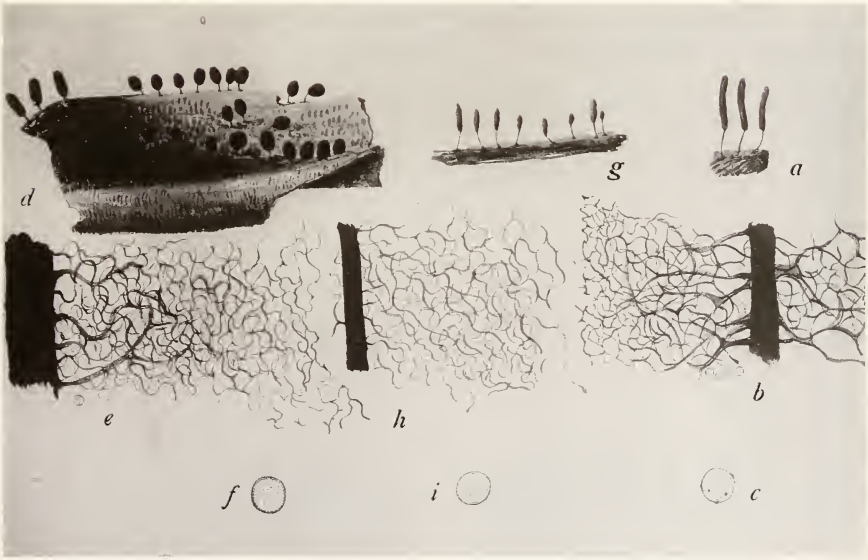
Lister pinx.

a—c COMATRICHA LURIDA List.
d—f—COMATRICHA RUBENS List.



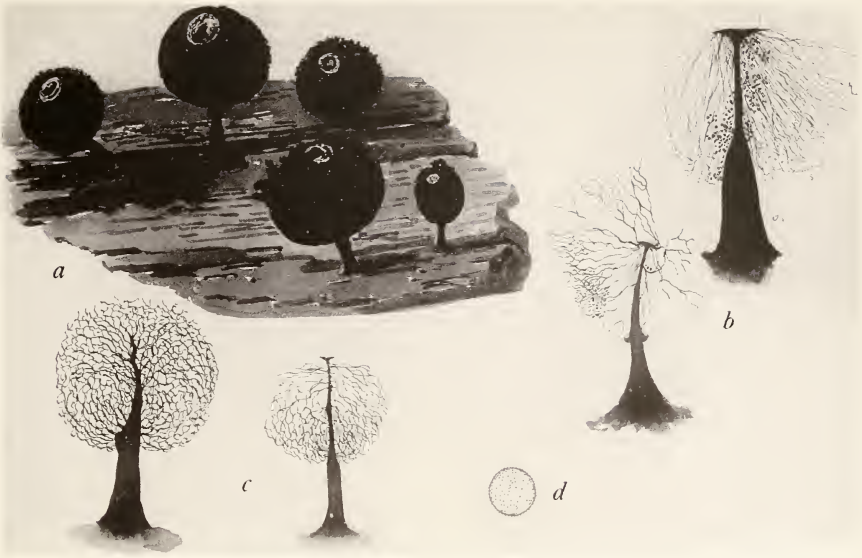
COMATRICHA TYPHOIDES Rost.

B



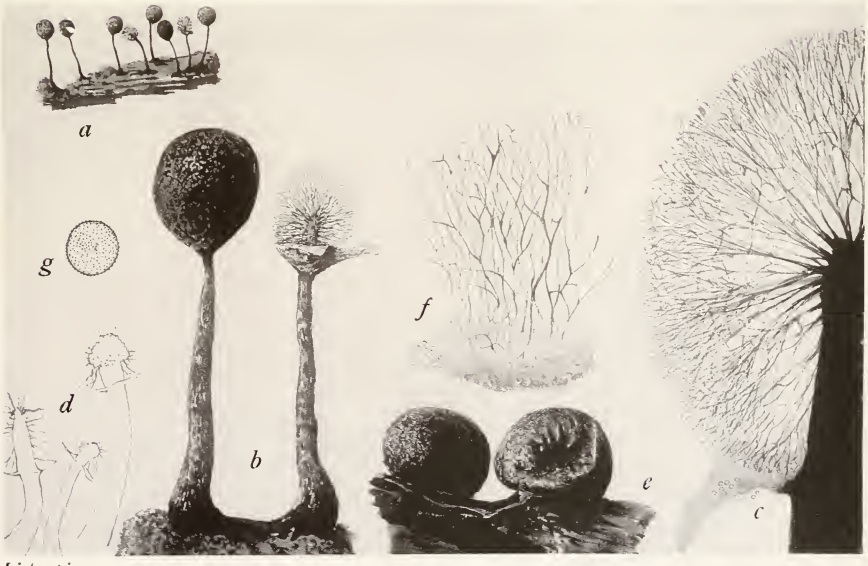
Lister pinx.

a—c COMATRICHA TYPHOIDES Rost.
d—i COMATRICHA PERSOONII Rost.



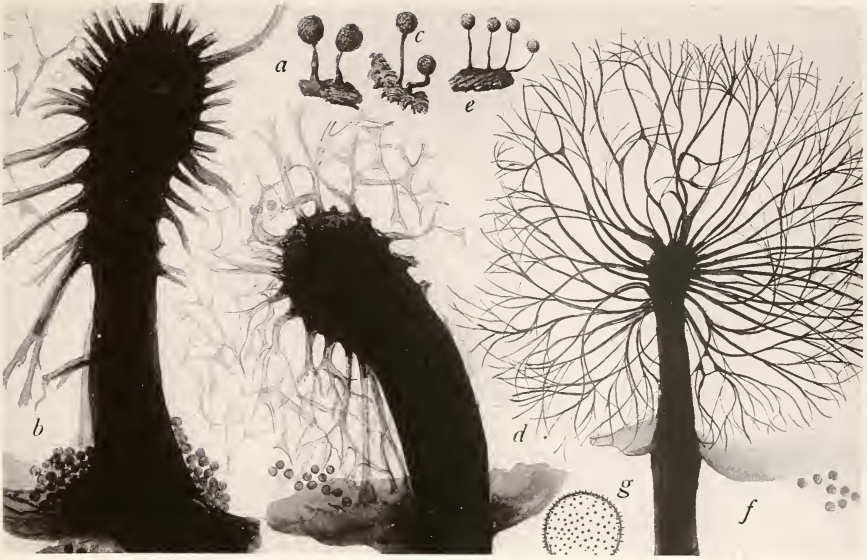
ENERTHENEMA ELEGANS Bowm.

B



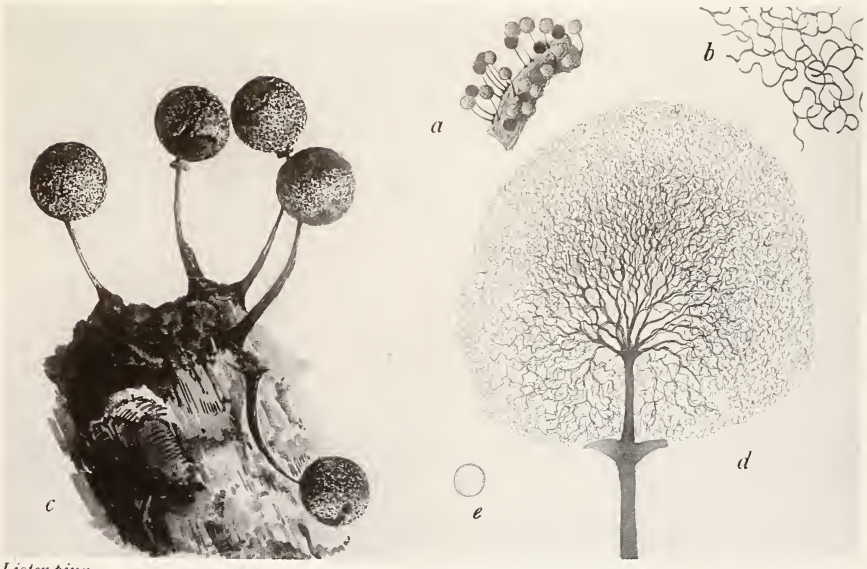
Lister pinx.

LAMPRODERMA PHYSAROIDES Rost.



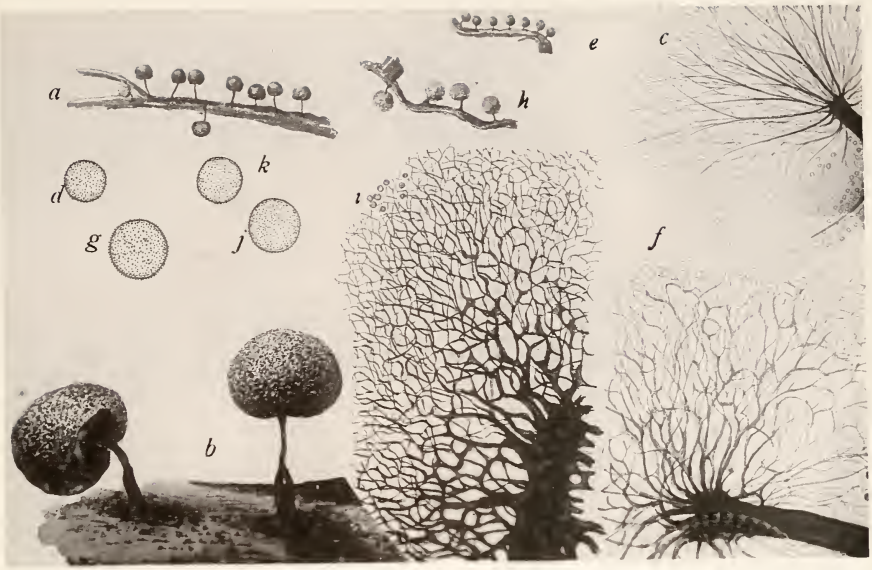
LAMPRODERMA ECHINULATUM Rost.

B



Lister pinx.

LAMPRODERMA ARCYRIONEMA Rost.

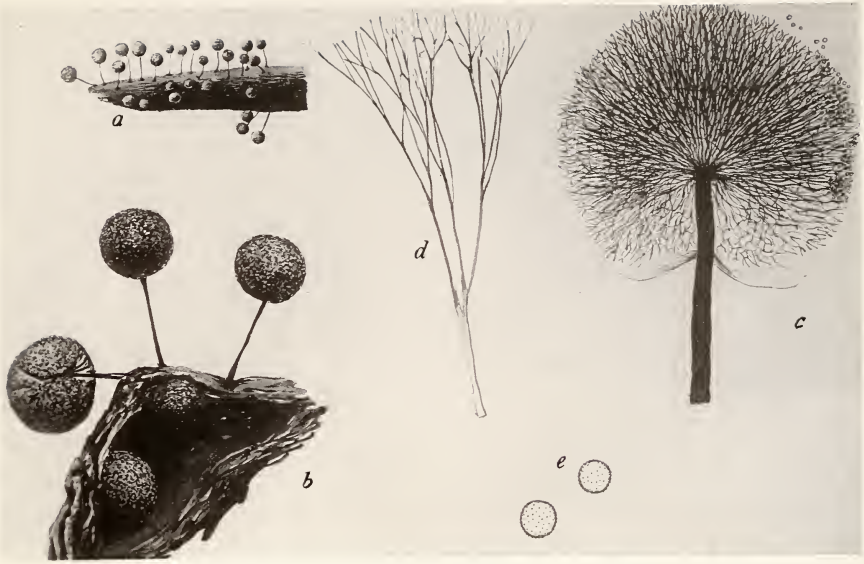


LAMPRODERMA VIOLACEUM Rost.

B

Lister pinx.

TYPE OF STEMONITIS ARCYRIOIDES Somm.

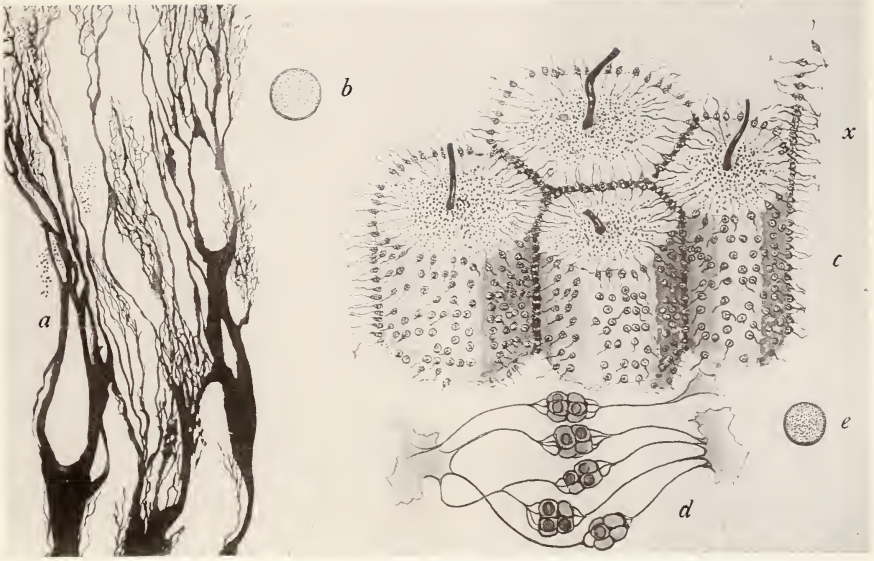


LAMPRODERMA IRIDEUM Mass.

B

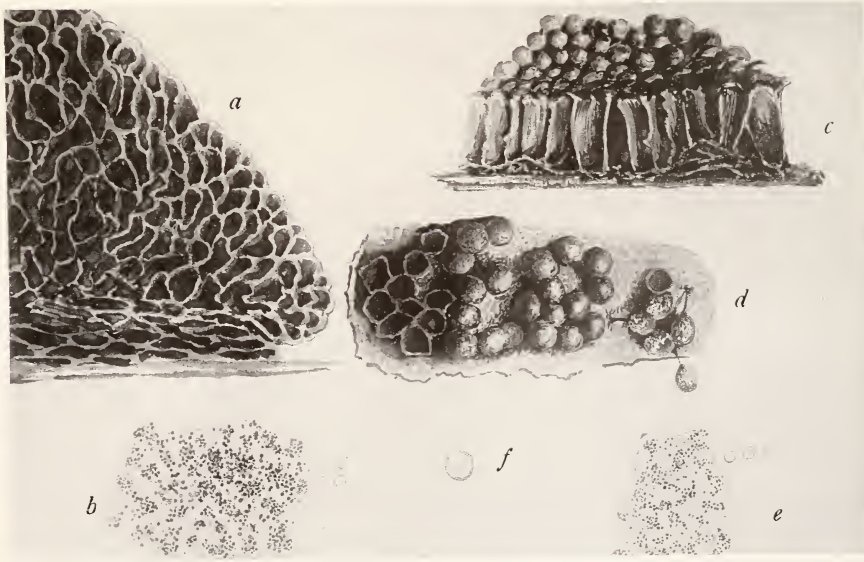
Lister pinx.

CLASTODERMA DEBARYANUM Blytt



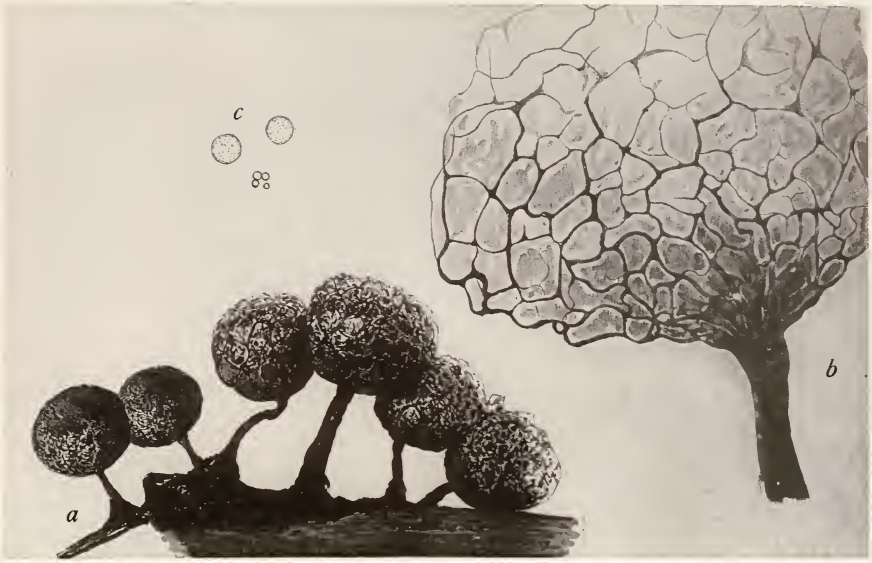
a, *b* AMAUROCHÆTE ATRA Rost.
c—*e* BREFELDIA MAXIMA Rost

B



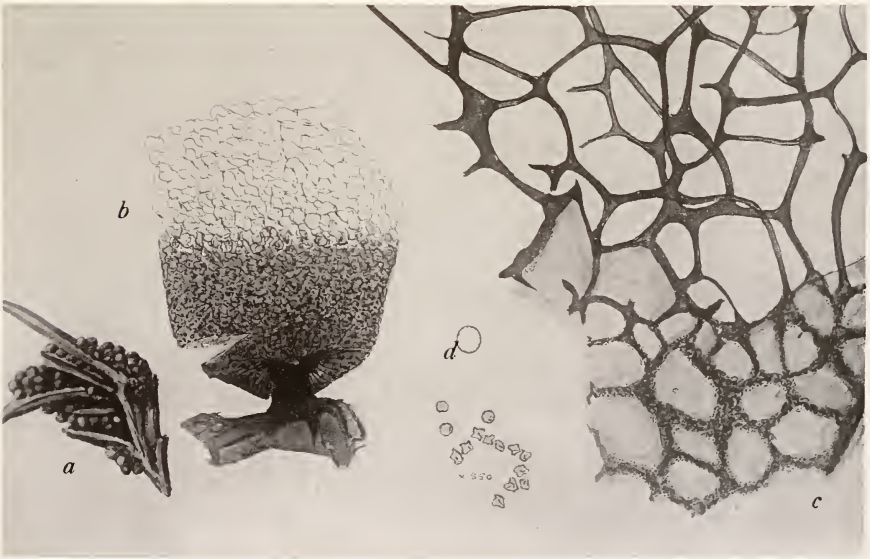
Lister pinx.

LINDBLADIA TUBULINA Fr.



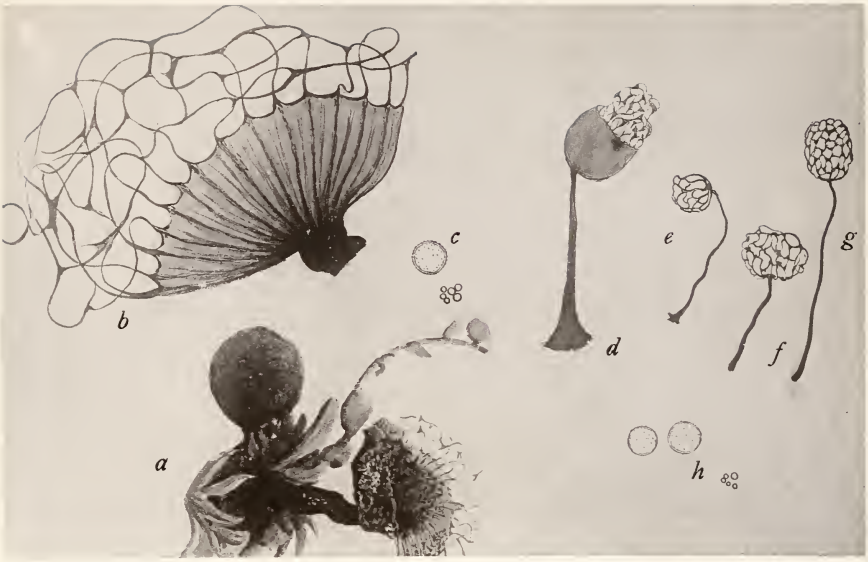
CRIBRARIA ARGILLACEA Pers.

B



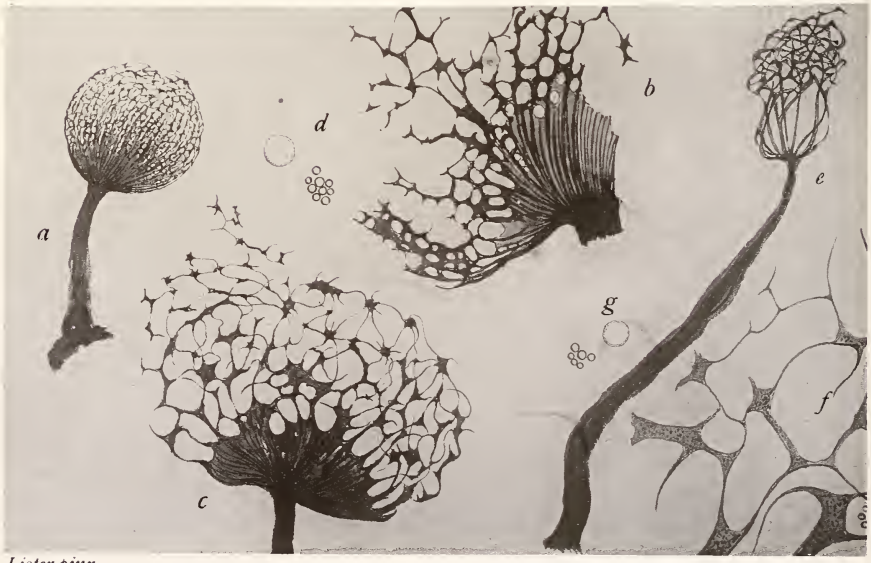
Lister pinx.

CRIBRARIA RUBIGINOSA Fr.



a—c CRIBRARIA RUFESCENS Pers.
d—h CRIBRARIA MINUTISSIMA Schwein.

B



Lister pinx

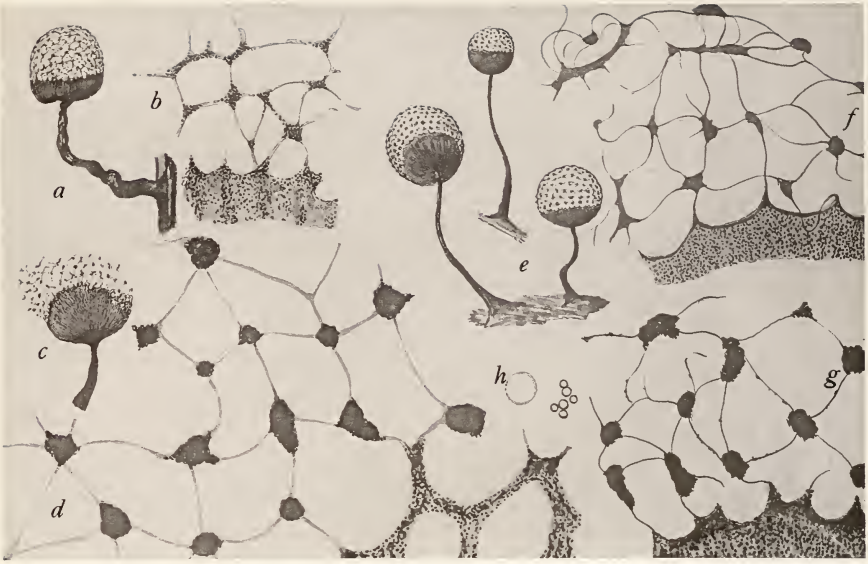
a—d CRIBRARIA MACROCARPA Schrad.
e—g CRIBRARIA SPLENDENS Pers.

CRIBRARIA AURANTIACA Schrad.

B

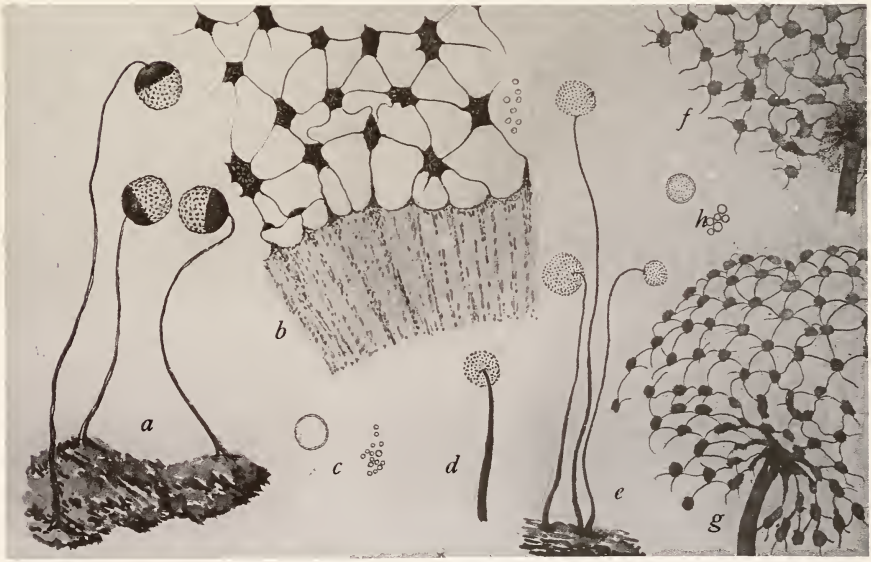
Lister pinx.

a—e CRIBRARIA INTRICATA Schrad.
f—i CRIBRARIA TENELLA Schrad.



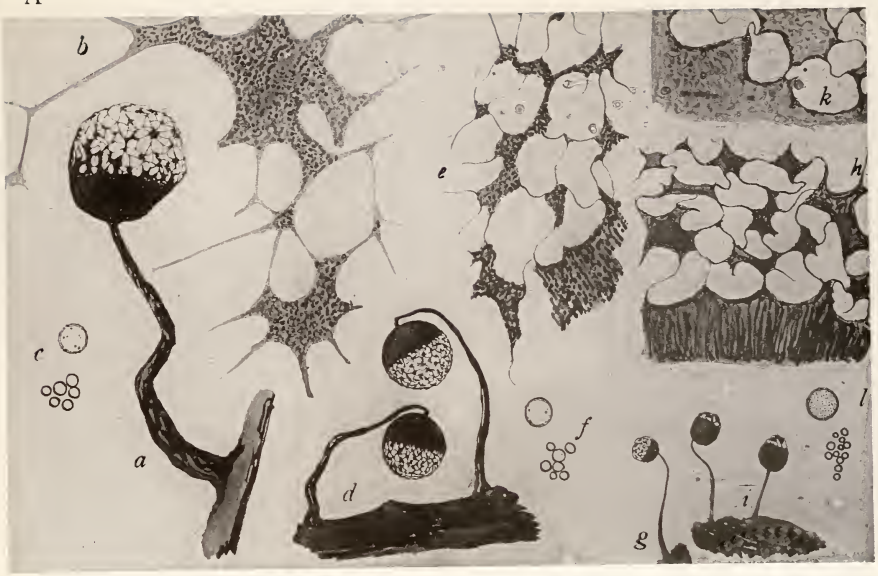
CRIBRARIA PYRIFORMIS Schrad.

B



Lister pinx.

a—c CRIBRARIA LANGUESCENS Rex
d—h CRIBRARIA MICROCARPA Pers.

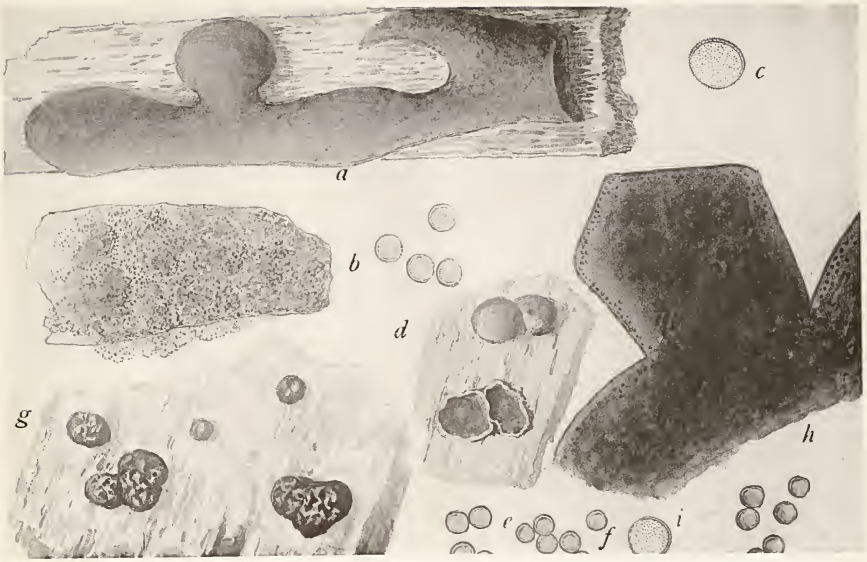


a—*c* CRIBRARIA PURPUREA Schrad
d—*f* CRIBRARIA ELEGANS Berk. & Curt
g—*l* CRIBRARIA VIOLACEA Rex

B

Lister pinx.

DICTYDIUM UMBILICATUM Schrad.

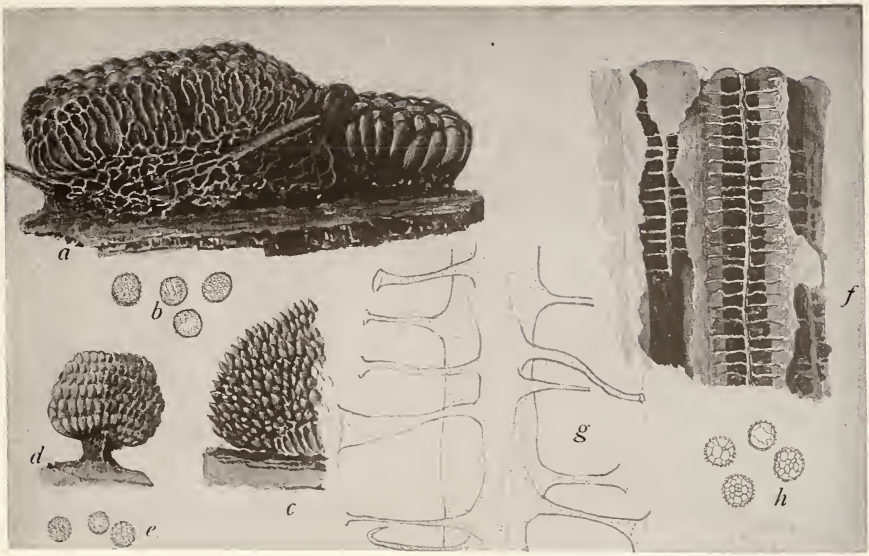


a—*c* LICEA FLEXUOSA Pers.
d—*i* LICEA MINIMA Fr

B

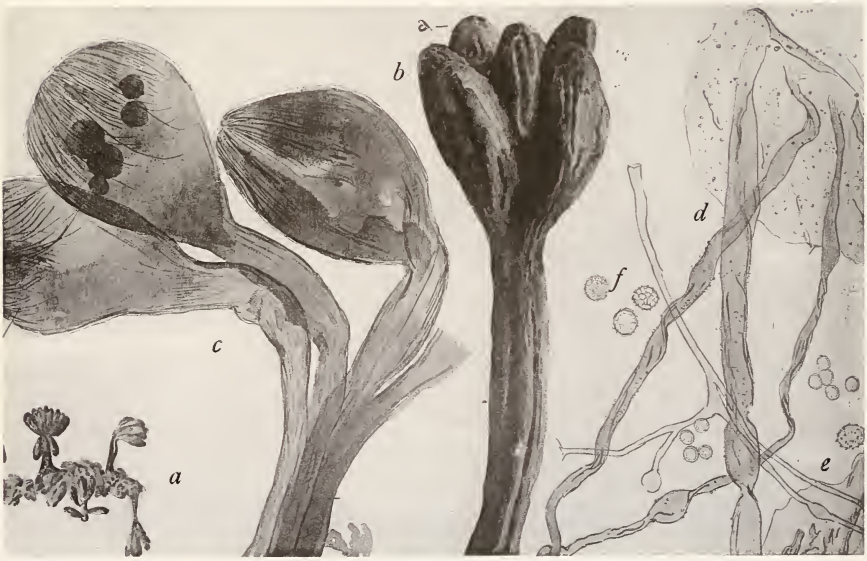
Lister pinx.

a—*c* LICEA PUSILLA Schrad.
d—*f* ORCADELLA OPERCULATA Wing.



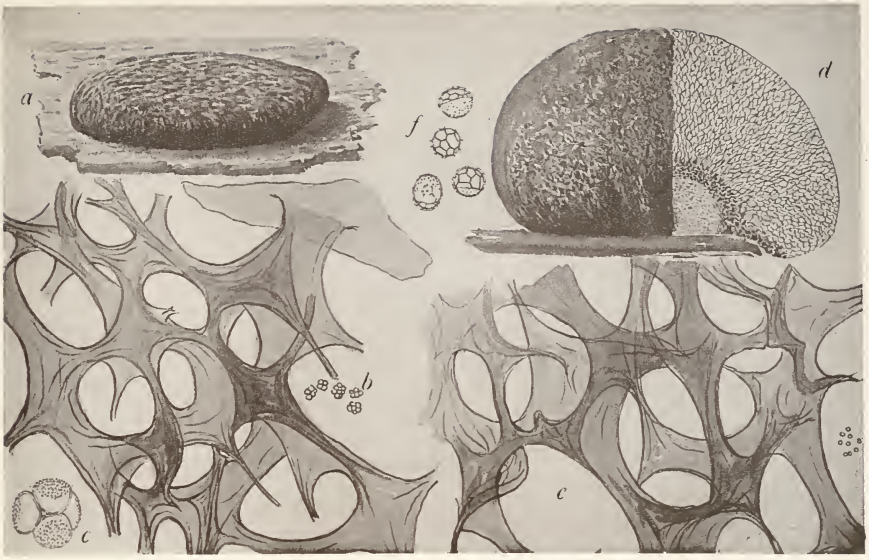
a—*c* TUBULINA FRAGIFORMIS Pers
d—*e* TUBULINA STIPITATA Rost
f—*h* SIPHOPTYCHIUM CASPARYI Rost.

B



Lister pinx.

ALWISIA BOMBARDA Berk. & Br.

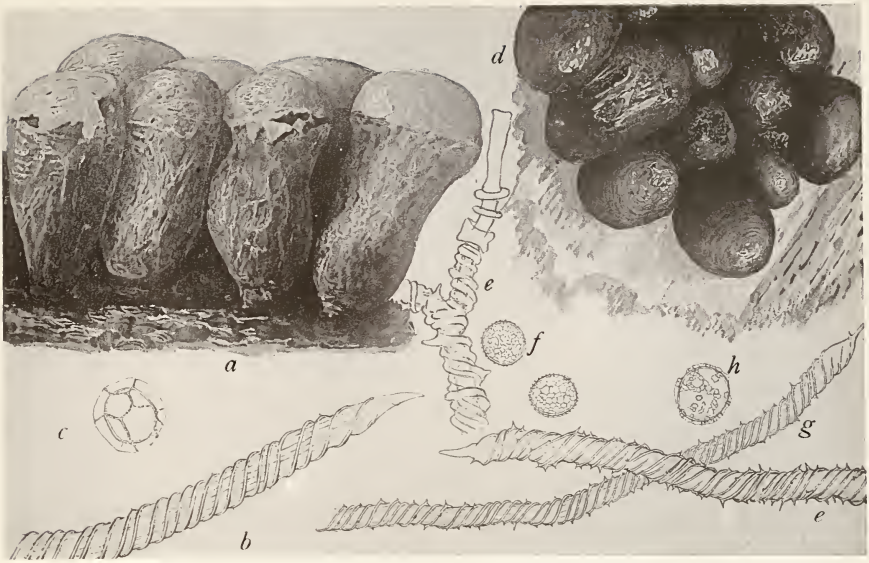


a—c ENTERIDIUM OLIVACEUM Ehrenb.
d—f ENTERIDIUM ROZEANUM Wing.

B

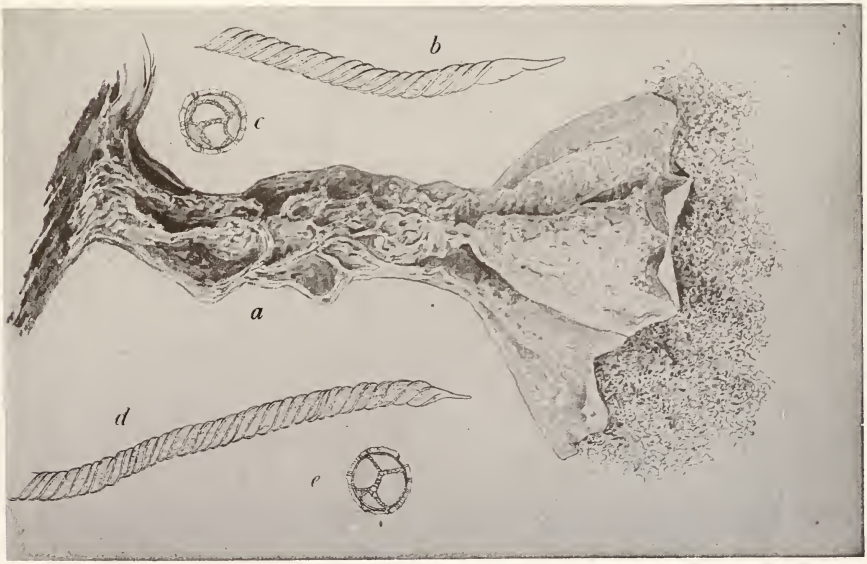
Lister pinx.

a—c RETICULARIA LYCOPERDON Bull.
d—f RETICULARIA LOBATA List.



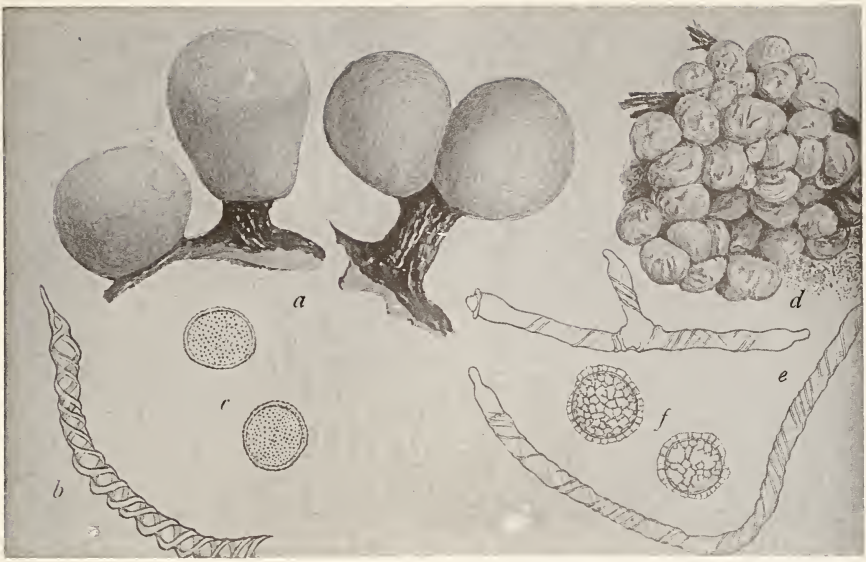
a—*c* TRICHIA FAVOGINEA Pers.
d—*f* TRICHIA SCABRA Rost.
g—*h* TRICHIA PERSIMILIS Karst.

B



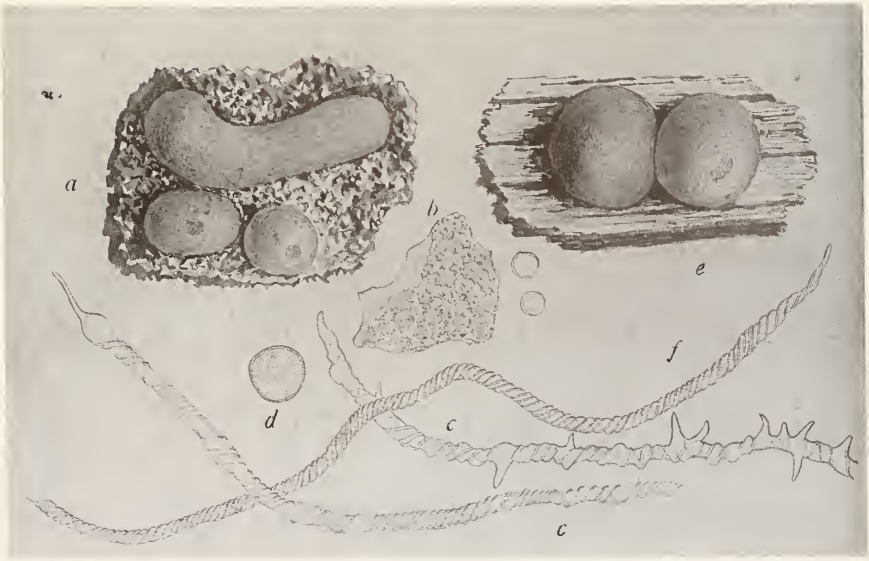
Lister pinx.

a—*c* TRICHIA VERRUCOSA Berk.
d—*e* TRICHIA AFFINIS de Bary



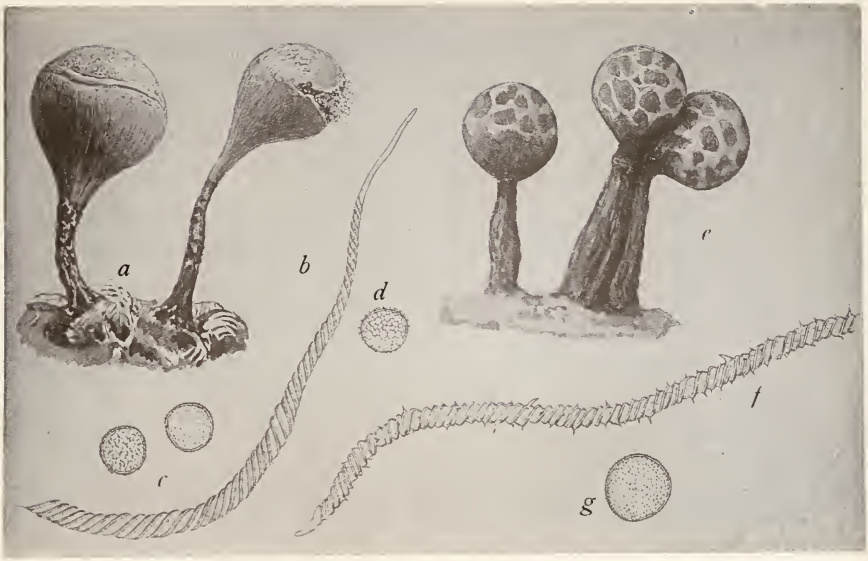
a—*c* TRICHIA VARIA Pers.
d—*f* OLIGONEMA NITENS Rost.

B



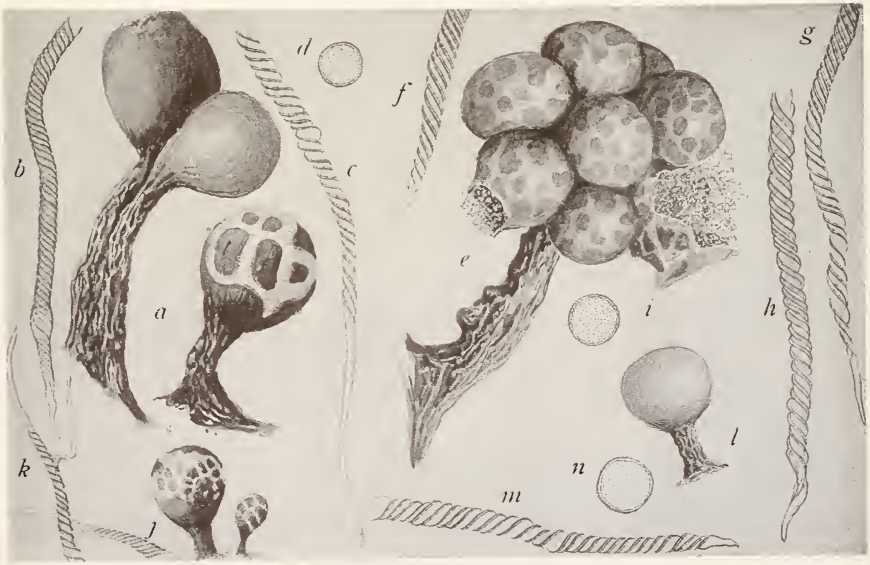
Lister pinx.

TRICHIA CONTORTA Rost



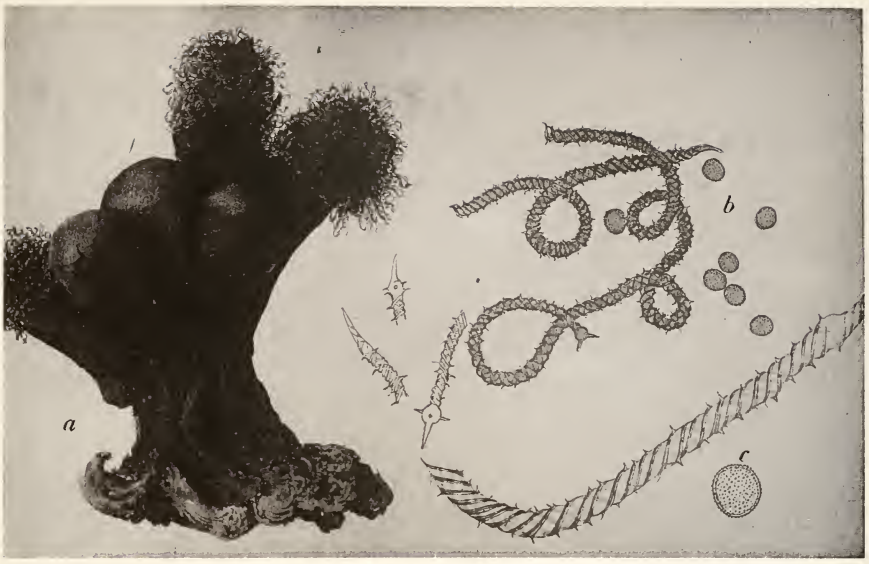
a—*d* TRICHIA FALLAX Pers
e—*g* TRICHIA ERECTA Rex

B



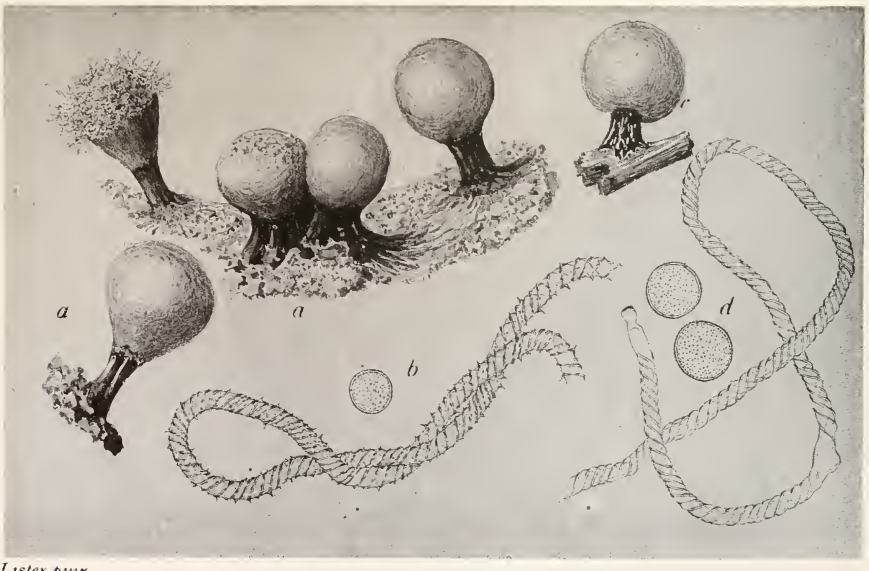
Lister pinx

TRICHIA BOTRYTIS Pers.



HEMITRICHIA RUBIFORMIS List.

B



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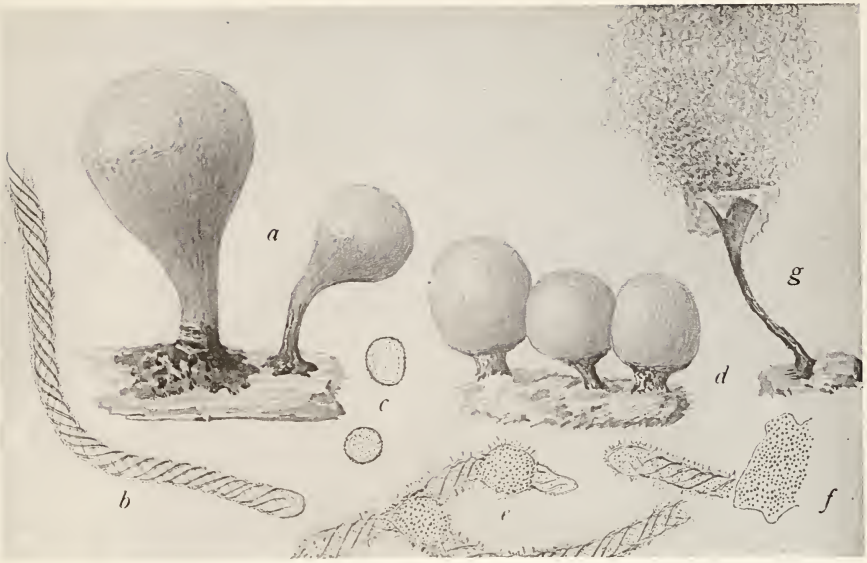
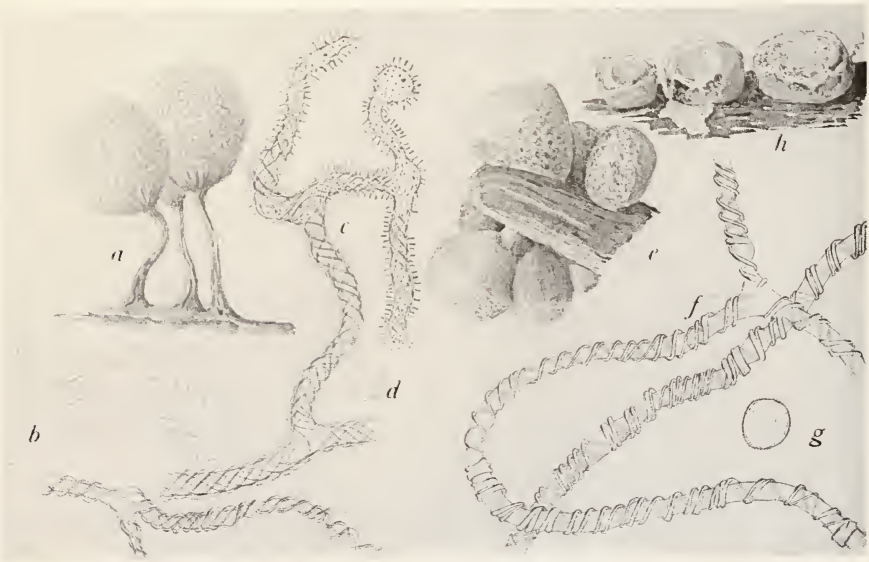
HEMITRICHIA INTORTA List.



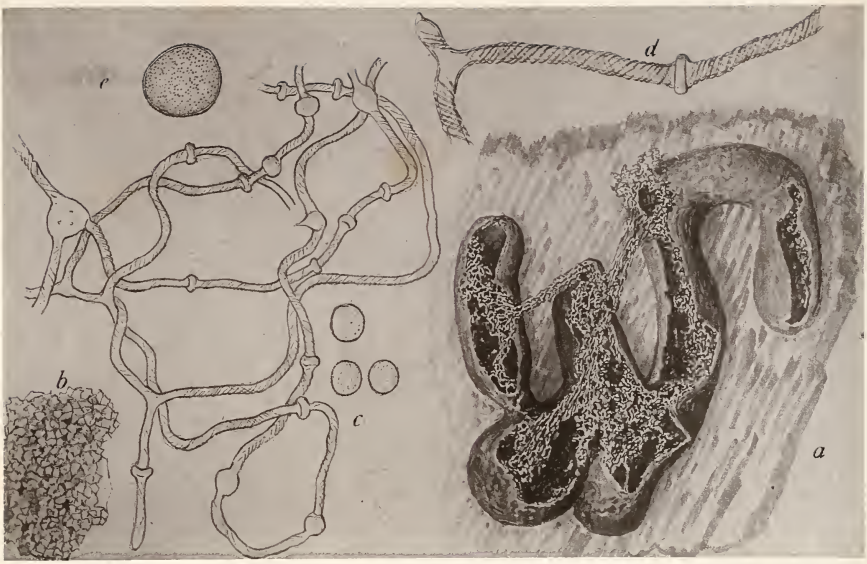
HEMITRICHIA CLAVATA Rost.

B



Lister pinx.

a—*d* HEMITRICHIA LEIOCARPA List.
e—*h* HEMITRICHIA WIGANDII List.



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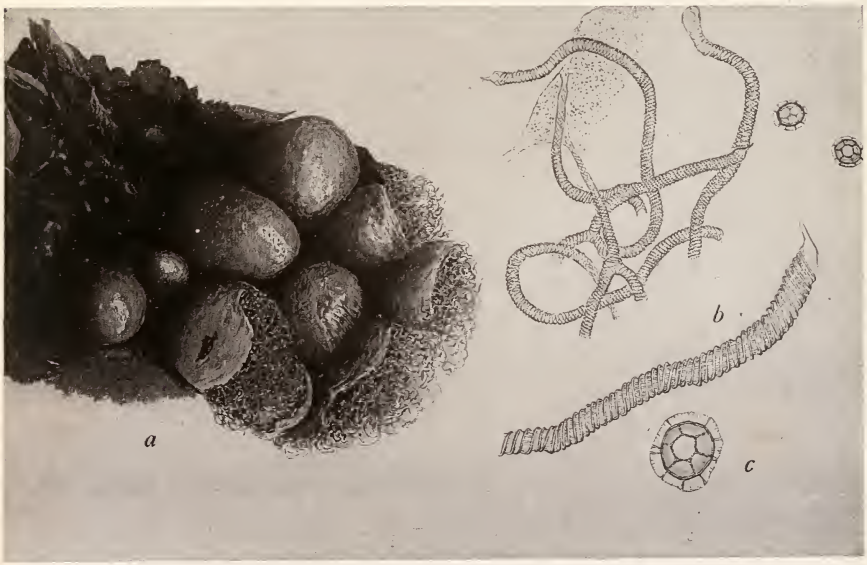

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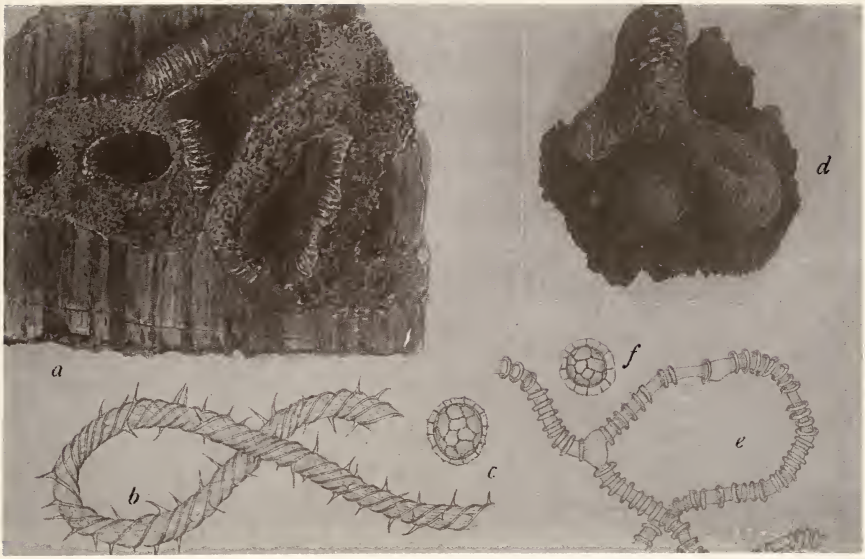
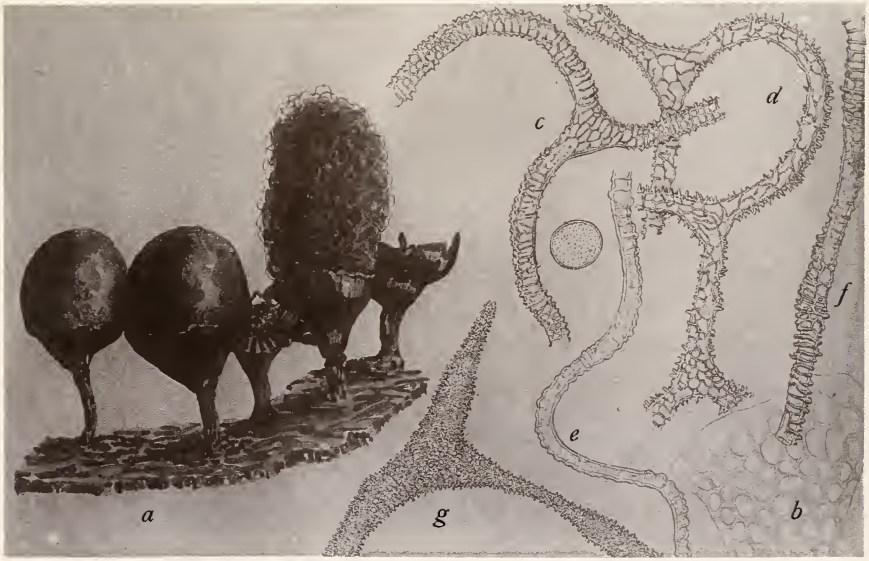


a—c HEMITRICHIA SERPULA Rost.
d—f CORNUVIA SERPULA Rost.

B



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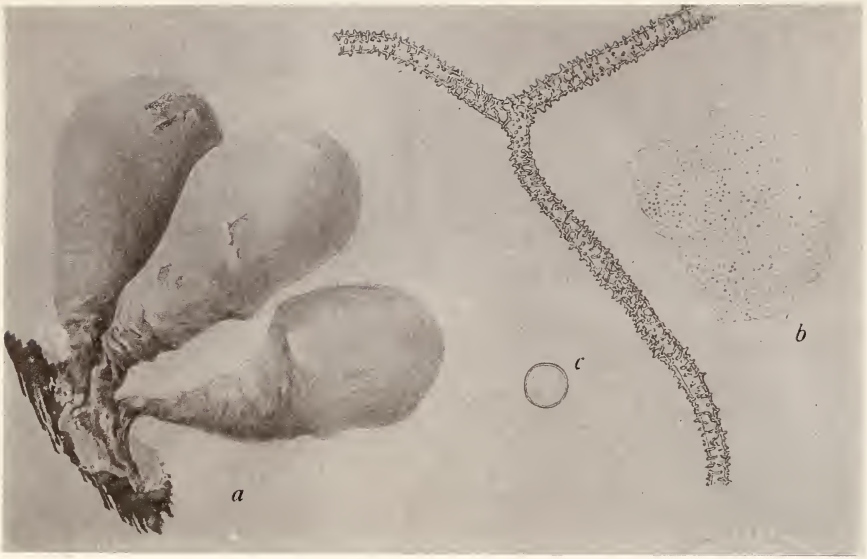
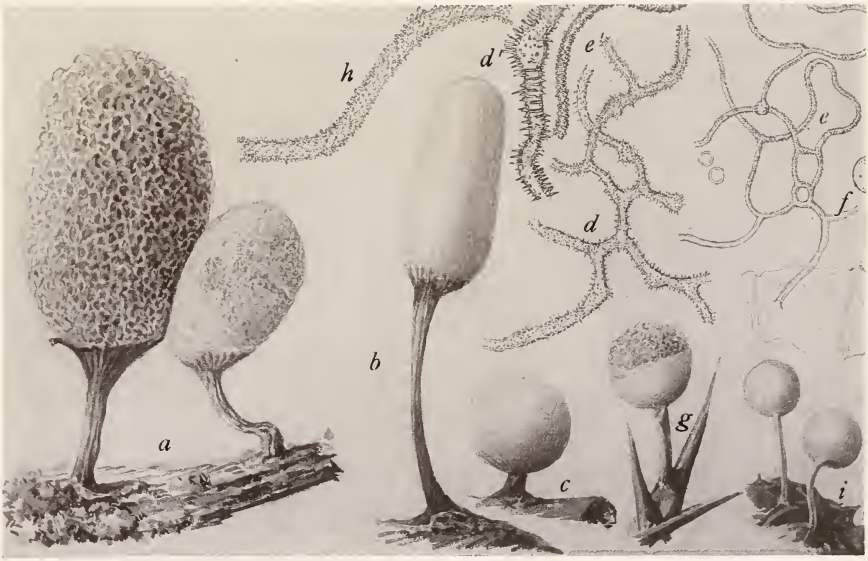
ARCYRIA FERRUGINEA Sauter



ARCYRIA VERSICOLOR Phillips

B



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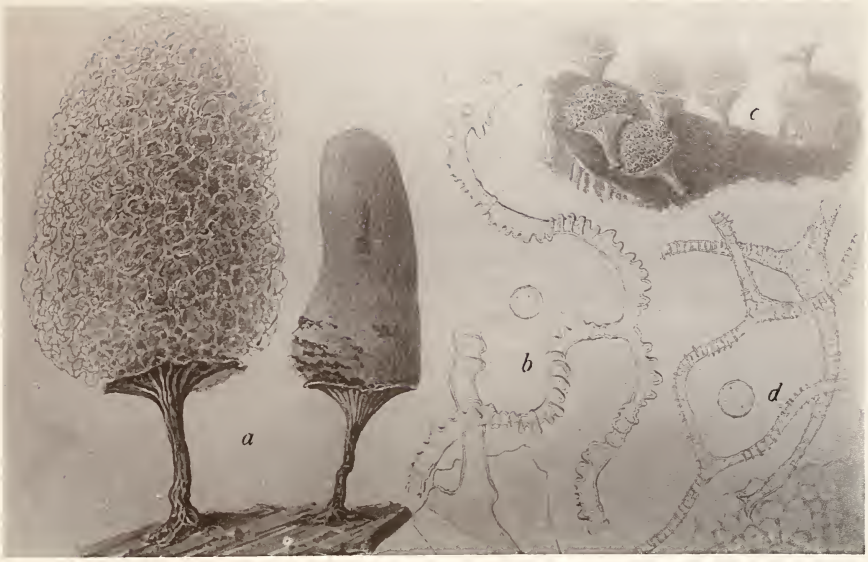
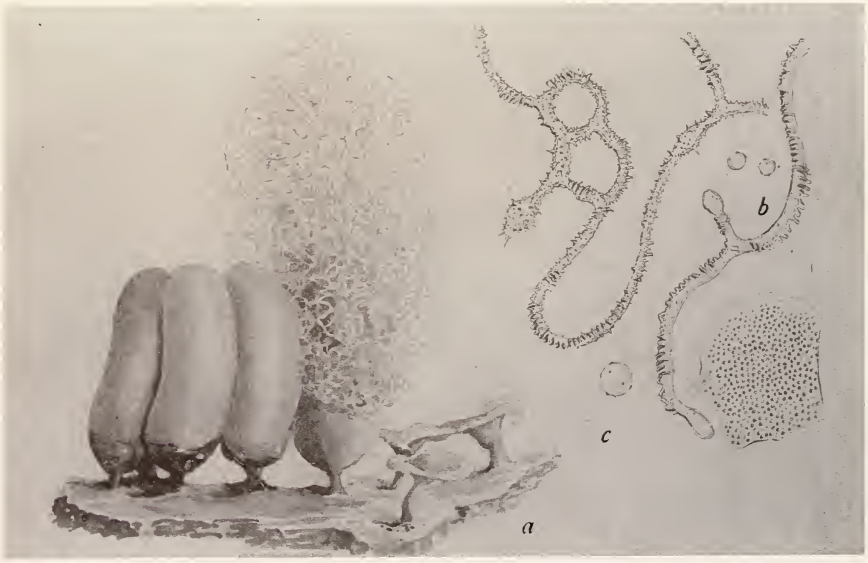
ARCYRIA ALBIDA Pers.



a, *b* ARCYRIA PUNICEA Pers.
c, *d* ARCYRIA INSIGNIS Kalchbr & Cooke

B



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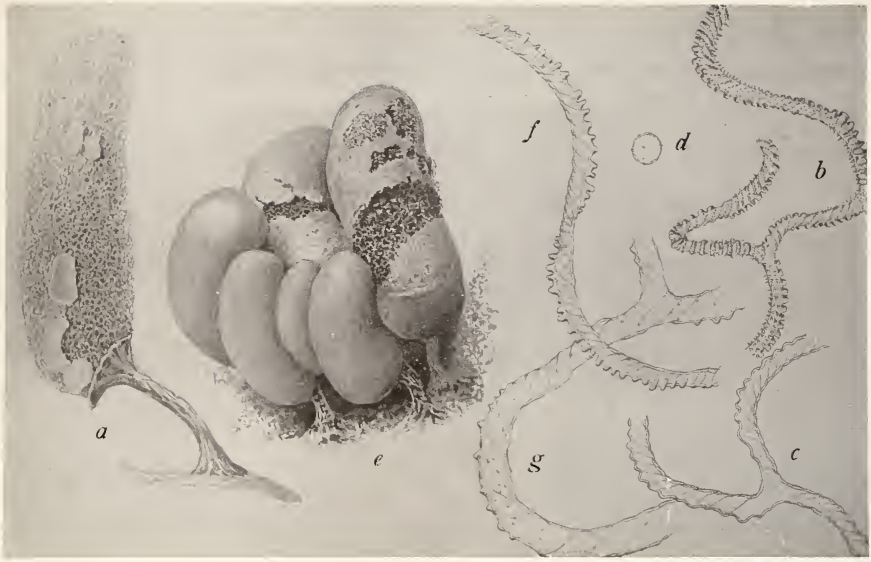
ARCYRIA INCARNATA Pers.

ARCYRIA FLAVA Pers

B

Lister pinx.

ARCYRIA ŒRSTEDTII Rost.



ARCYRIA STIPATA List

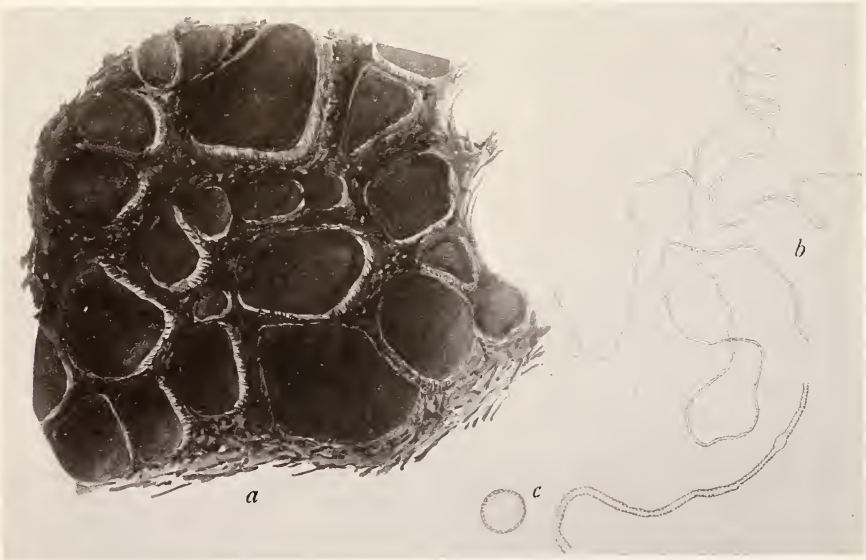
B

Lister pinx.

LACHNOBOLUS CIRCINANS Fr.

PERICHÆNA CHRYSOSPERMA List.

B



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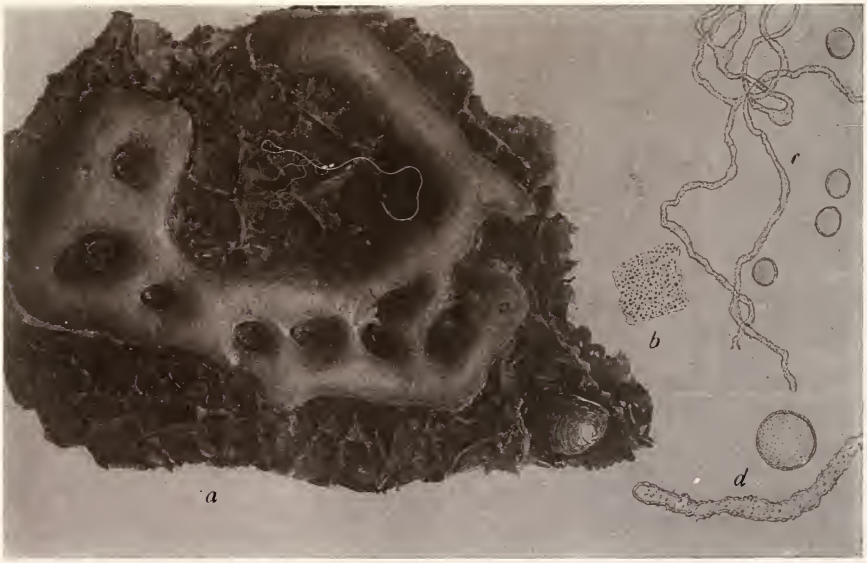
PERICHÆNA DEPRESSA Lib.

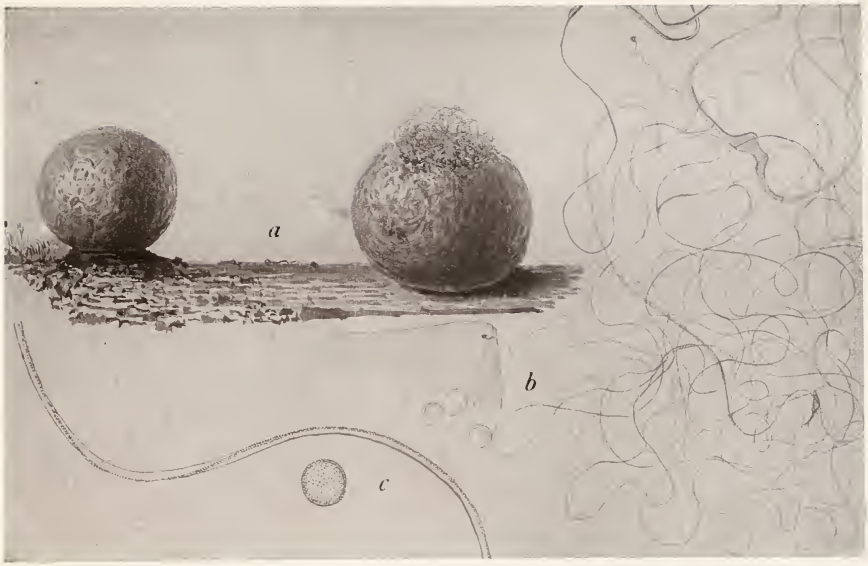
PERICHÆNA POPULINA Fr.

B



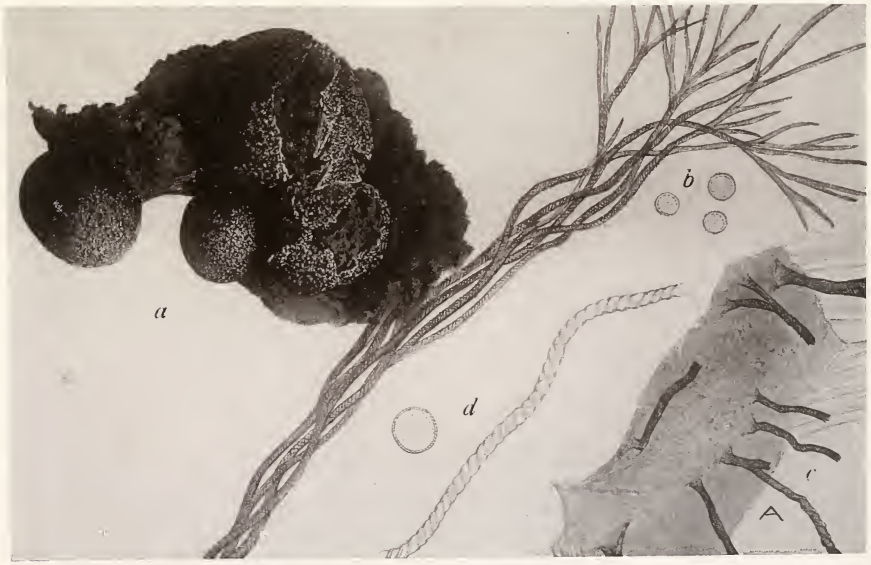
Lister pinx

PERICHÆNA VARIABILIS Rost.



MARGARITA METALLICA List.

B



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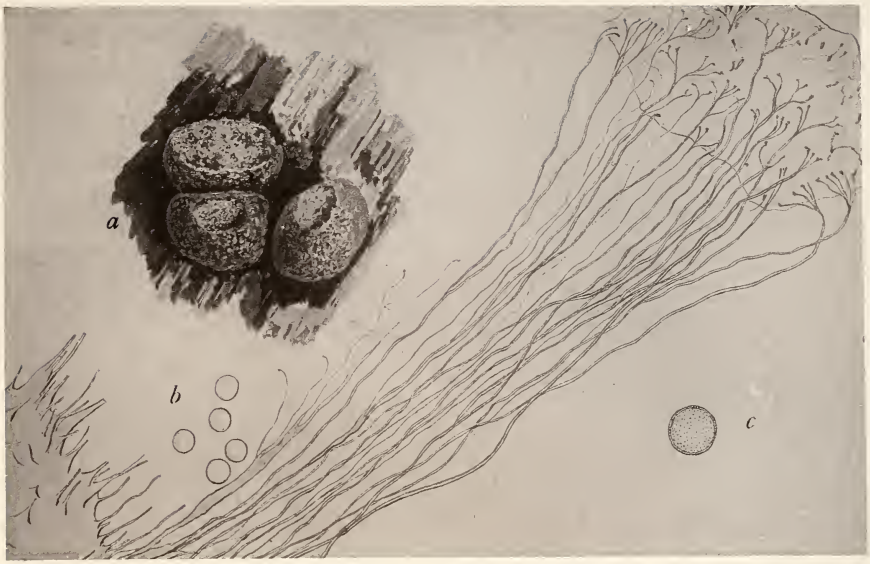
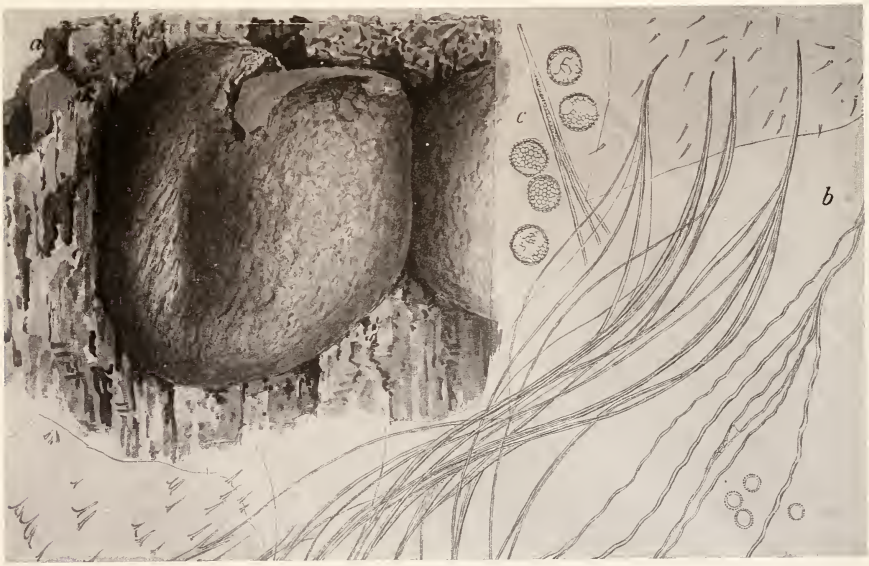
PROTOTRICHIA FLAGELLIFERA Rost



DIANEMA HARVEYI Rex

B



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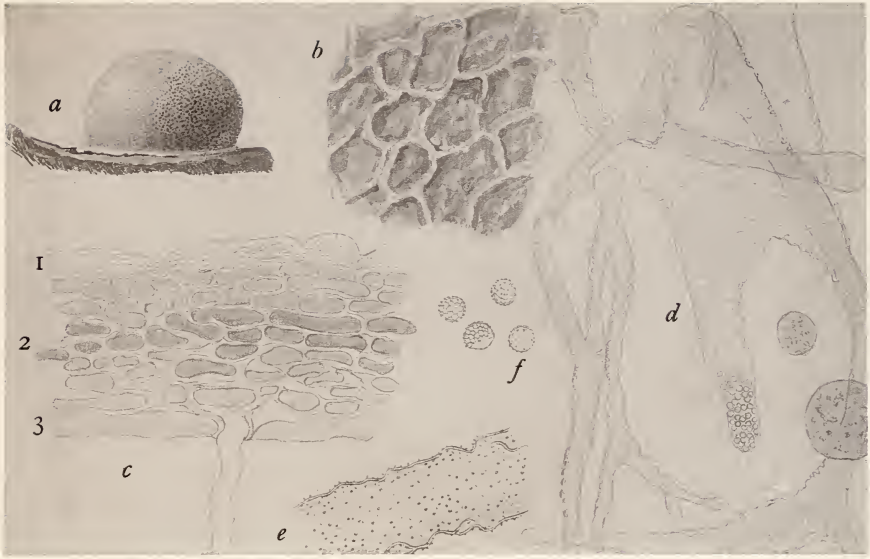
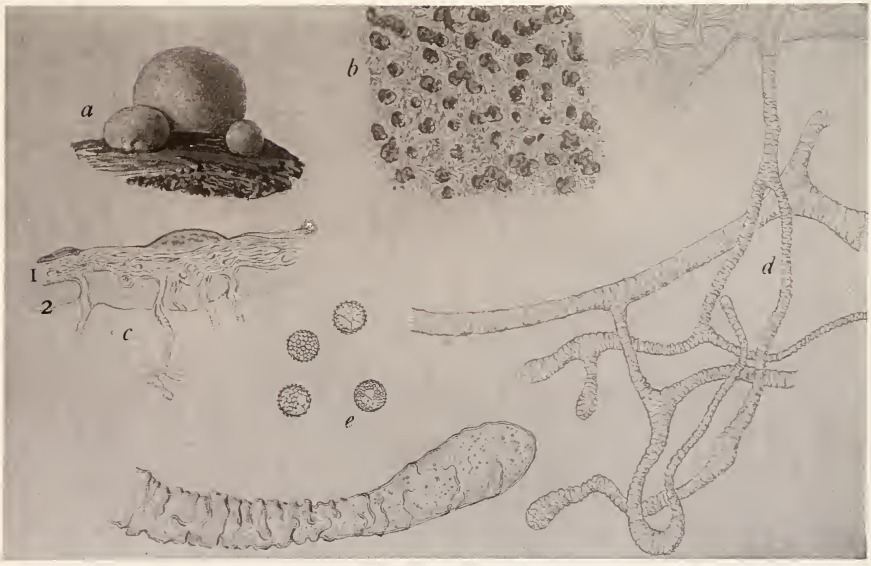


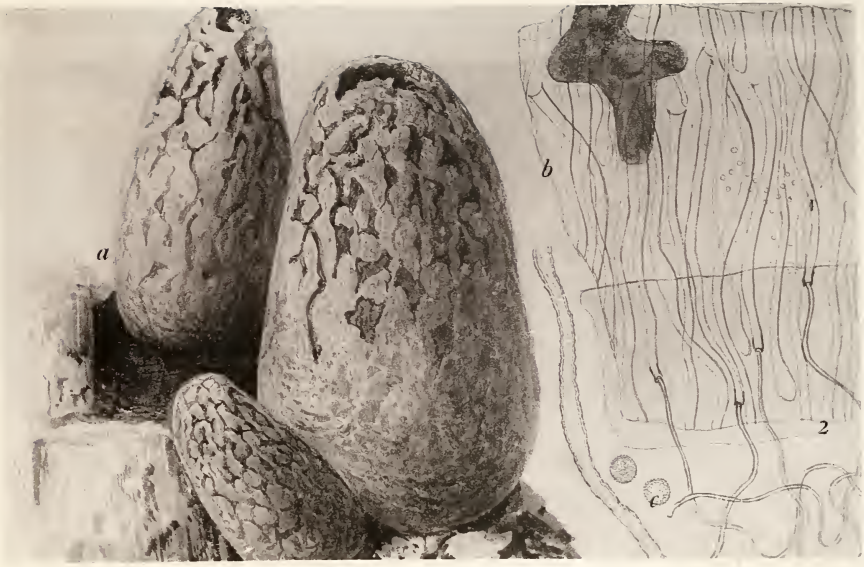
LYCOGALA FLAVO-FUSCUM Rost

B



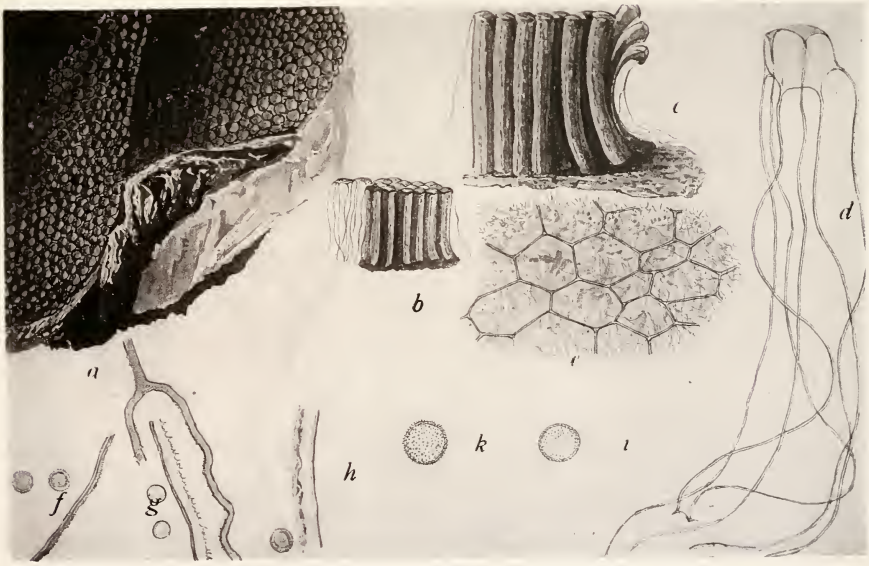
Lister pinx

LYCOGALA MINIATUM Pers



LYCOGALA CONICUM Pers.

B



Lister pinx.

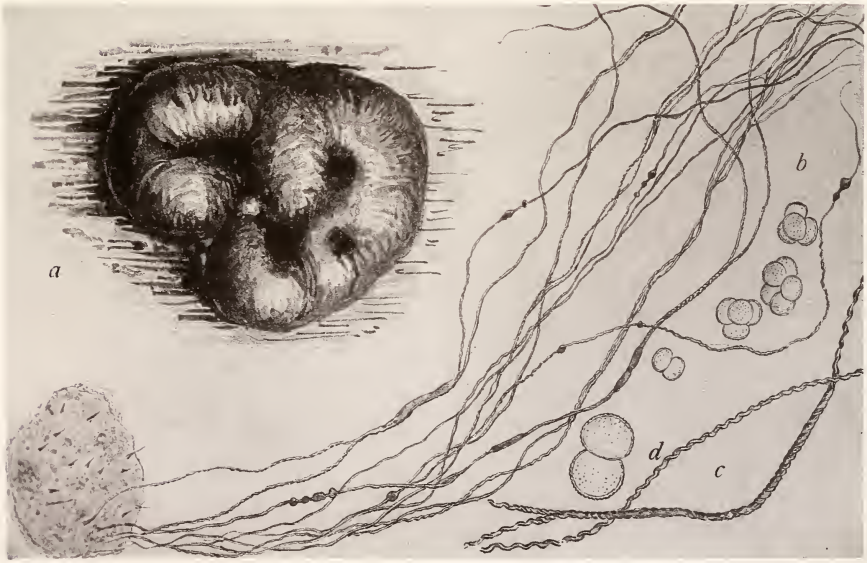
DICTYDIÆTHALIUM PLUMBEUM Rost

A

Pl. LXXVII.

STEMONITIS FUSCA Roth Var. CONFLUENS

B



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